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CIS

CRITICAL TECHNOLOGIES: MACHINE TOOLS, ROBOTICS, AND MANUFACTURING

HEARING

BEFORE THE

SUBCOMMITTEE ON
TECHNOLOGY AND COMPETITIVENESS

OF THE

COMMITTEE ON
SCIENCE, SPACE, AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED SECOND CONGRESS

FIRST SESSION

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CRITICAL TECHNOLOGIES: MACHINE TOOLS, ROBOTICS, AND MANUFACTURING

THURSDAY, MAY 9, 1991

U.S. House of Representatives,
Committee on Science, Space, and Technology,
Subcommittee of Technology and Competitiveness,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10:00 a.m. in room 2325, Rayburn House Office Building, Hon. Tim Valentine [chairman of the subcommittee] presiding.

Mr. Valentine. May we get started, please.

I think, I'll share with the group what I just shared with my dear friend from Florida, Mr. Lewis.

I have a colleague, who will remain nameless, that I asked yesterday what he was going to do about the Gun Control Bill, and he said that gun control in his District means having a steady aim. [Laughter.]

Mr. Valentine. Good morning, ladies and gentlemen, and welcome to the Subcommittee of Technology and Competitiveness. This morning we want to hear about how we can move manufacturing, machine tools, and robotics technologies from being recognized as critical, to the factory floor. Our manufacturing industries have not kept pace with our foreign competitors. Therefore, we want to explore some of the alternatives available to U.S. manufacturers, to revitalize these industries.

The Office of Science and Technology's National Critical Technologies Panel recognized the importance of manufacturing. They categorized it as one of the three building block technologies. However, today's manufacturing cannot be viewed as a single entity. It includes the integration of other technologies, as well as sensors, simulation and modeling, and computer software and hardware, for example.

The machine tool and robotics industries in the United States over the last decade have not kept pace with foreign competitors. In 1988 Japan installed $2.5 billion of new robots for a total of approximately 220,000 robots in the country. In 1989, the U.S. purchased $400 million worth of robots for a total of approximately 37,000 in the United States. Japan adds more robots in a year than the total number of these contraptions in the United States.

Although robots have been used here and abroad to lower production cost, the United States robotics industry has had a difficult time getting off the ground. Large U.S. manufacturers, such as General Motors, have been increasingly purchasing these products from the Japanese. The Japanese companies were large, sophisticated and better financed and made dramatic inroads in the U.S. markets.

In 1983, the National Machine Tool Builders Association requested protection, because of national security concerns. In 1986, the President sought a Voluntary Restraint Agreement on machine tool imports and issued an action plan to ensure that the United States machine tool industry would be world class. Both of these are temporary fixtures. Yet, only today are major efforts underway to take a big picture look at the competitiveness situation in these industries.

Our manufacturing sector, this very day, is having serious problems remaining competitive in a tight automotive market, while some of the Japanese manufacturers are gaining in sales.

New technologies are helping U.S. manufacturers to compete. Foreign competitors are also using new technologies. However, they seem to use the technology more effectively, thereby increasing their competitiveness. U.S. ideas and innovations are being used to enhance foreign manufacturing capabilities. U.S. manufacturers are not capitalizing on technology to the same extent as their competitors.

An article in Forbes, last year, discussed the reception that one of our witnesses, who is here today, received in Japan in comparison with his reception in the United States. In Japan, Dr. Engleberger is considered to be a guru but this is not the case at home in the United States. The article quotes the distinguished gentleman as saying "I had a hard time getting people in the United States to take me seriously." I hope that times, as they say, are changing and that this hearing, here today, will increase the emphasis on the need for immediate action on the part of the Administration, on the part of private companies, and, of course, on the part of the United States Congress.

Again, I welcome the witnesses and others here today.

[The prepared statement of Mr. Valentine follows:]

OPENING STATEMENT

CHAIRMAN TIM VALENTINE

Subcommittee on Technology & Competitiveness

Critical Technologies:

Machine Tools, Robotics & Manufacturing

May 9, 1991

Good morning and welcome to the Subcommittee on Technology and Competitiveness. This morning we want to hear about how we can move manufacturing, machine tools and robotics technologies from being recognized as critical -- to the factory floor. Our manufacturing industries have not kept pace with our foreign competitors. Therefore, we want to explore some of the alternatives available to U.S. manufacturers, to revitalize these industries.

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The machine tool and robotics industries in the U.S. over the last decade have not kept pace with foreign competitors. In 1988 Japan installed 2.5 billion dollars of new robots for a total of approximately 220,000 robots in the country. In 1989, the U.S. purchased 400 million dollars worth of robots for a total of approximately 37,000 in the U.S.. Japan adds more robots in a year than the total number of robots in the U.S.

Although robots have been used here and abroad to lower production cost, the U.S. robotics industry has had a difficult time getting off the ground. Large U.S. manufacturers, such as General Motors, have been increasingly purchasing their robots from the Japanese. The Japanese companies were large, sophisticated and better financed and made dramatic in-roads into U.S. markets.

In 1983, the National Machine Tool Builders Association requested protection, because of national security concerns. In 1986, the President sought a Voluntary Restraint Agreement on machine tool imports and issued an action plan to ensure that the United States machine tool industry would be world class. Both are temporary fixes. Yet, only today are major efforts underway to take a "big picture" look at our competitiveness problems in these industries.

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An article in FORBES, last year, discussed the reception that one of our witnesses receives in Japan in comparison with his reception in the U.S. In Japan, Mr. Engleberger is considered to be a guru but this is not the case at home in the U.S. The article quotes Mr. Engleberger as saying "I had a hard time getting people in the U.S. to take me seriously." I hope that times are changing and that this hearing will increase the emphasis on the need for immediate action on the part of the administration, private companies and the

Congress to reverse current trends. Again welcome to the hearings! I look forward to your testimony.

Mr. **Valentine**. It is my pleasure to recognize the distinguished ranking member of the subcommittee, the gentleman from Florida, Mr. Tom Lewis.

Mr. **Lewis**. Thank you Mr. Chairman.

I was pleased to see that the Office and Science and Technology Policy on Critical Technologies included manufacturing. For too long, we have placed the emphasis on improving our manufacturing and not placed the emphasis on our manufacturing technology. As a consequence, we have started to fall behind in our ability to be able to compete.

I hope today's witnesses will provide some insight into this dilemma and that we can enhance our manufacturing competitiveness and technology. That will certainly head us in the right direction.

Thank you, Mr. Chairman.

Mr. **Valentine**. Thank you, sir.

At this time, I will recognize the distinguished lady from Missouri, Ms. Horn.

Ms. **Horn**. Thank you, Mr. Chairman, and thank you for holding this hearing.

I do want to concur with the comments you've made. We have a distinguished panel and I am very interested in hearing their comments so, I have no further opening statement.

Thank you.

Mr. **Valentine**. Thank you, ma'am.

The first panel consists of the gentleman who I have already introduced partially, at least mentioned, Mr. Joseph Engleberger from the Transitions Research Corporation in Danbury, Connecticut, Dr. Richard Kegg from Cincinnati Milacron in Cincinnati, Ohio, and Dr. Ruben F. Mettler, the retired Chairman of the Board and Chief Executive Officer of TRW, Inc. in Washington, D.C.

I would ask you to summarize, if you would. Your prepared statements will appear in the record as presented to us.

Before I mention that, I have to tell you that I will need to leave around 10:00. We will make other arrangements, with respect to the presiding officer. Ms. Horn will preside for a while, but must leave for a while, also. Mr. Lewis will take over. There will be somebody here. I just wanted for you to understand that, when we begin to shuffle around.

We want to be sure that we do not ask you to come and have you sit around. We will arrange to proceed in that fashion. If you will summarize, we will appreciate it.

Mr. Engleberger?

STATEMENT OF JOSEPH ENGLEBERGER, TRANSITIONS RESEARCH CORPORATION, DANBURY, CONNECTICUT

Mr. **Engleberger**. Thank you, Mr. Chairman, and ladies and gentlemen.

Your opening statements were a great thing for me to start with because robotics figured so strongly in those statements. The robotics situation is a microcosm of the overall problem. I am going to concentrate on robotics.

The robot was born in the United States. We developed the technology and the applications. As you indicated, Japan practically owns that industry today. Two thirds of the machines in the world are produced in Japan. The per capita density is seven fold that in the U.S.A.

A viewpoint that may not be shared is that American giant corporations such as, General Electric, Westinghouse, IBM, AT&T, and United Technology treated robotics in this country as a commodity. They dumped to get market share. They abandoned R&D and then, in disenchantment, liquidated, leaving the entrepreneurs and people in the business in chaos.

Japanese companies, meanwhile, took a long view. They nurtured the technology and their customers, first, building a domestic base and then fanning out globally.

From the very beginning, the United States research and development were superior. Even today, it is superior. We failed in the exploitation of our technology. The Japanese are the implementors and we remain the dilettantes.

The long view is so critical. I've made 25 trips to Japan and I've never had a Japanese executive talk to me about return on investment, discounted cash flow, or payback period. They want to know about performance, quality, and reliability. The decision makers are engineers and manufacturing executives, not bean counters.

In 1967, I flew to Japan as a guest of the government. After being royally entertained for a week, I spoke to 500 Japanese executives in Tokyo about robotics. Their enthusiasm kept me on the dias for 4 1/2 hours.

Senior Japanese corporate executives lent their names and their time, and the Japan Industrial Robot Association was formed three years before we had a Robot Industries Association. The same corporations I mentioned that brutalized the business in the United States, would provide no support in the formative years, be it finance or merely endorsement.

What happens is a new frontier. Bob asked me if it was too late for us as industrialists, maybe not. It's certainly not too late in the frontier of robotics for them to be placed in service activities. It's a manufacturing and a business opportunity. As is turns out, the opportunities in service are vastly greater than they are in manufacturing. Productivity in service jobs can be just as important as other kinds of productivity.

I put my book, Robotics in Service, into evidence.

[The referenced book is available in Subcommittee files.]

Mr. ENGLEBERGER. In the United States today, we have a scrawny organization called the National Service Robot Association hanging by its fingernails. Once again, we have the best technology and the best vision of the applications.

I go around with this mantle of "Father Robotics," which is translated immediately when I get to Japan as "Father of Japanese Robotics." In the United States, I have been making the rounds among large logical U.S. corporations to find a sponsor for the technology I'm talking about. We were written up, as the Chairman said, in Forbes and in Barron's, along with great television exposure. All to no avail, in this country.

There is deja vu for me because in February of this year, I was again invited to Japan. The title for my lecture was chosen by my hosts, "Robots and Humans, Shoulder to Shoulder." Japanese companies are seeing the potential that I speak of. I wager that my long term support will come from Japan, unless their level of self-confidence makes them decide to soak up what we've published and bypass us entirely.

One of the questions in the statement is what about the U.S. Government agencies? What should they do? I'm intimidated by the pictures in this room, but I can tell you that NASA has a Flight Telerobotic Servicer, FTS, that has grown from $90 million to $800 million on the weakest justification. The United States Postal Service, meanwhile, can't budget $1 million to develop a washroom cleaning robot, which has a tremendous terrestrial potential.

NASA, meanwhile, has the arrogance to project domestic fallout from fantastically expensive space hardware which I am perfectly willing to argue is ill conceived for its intended use.

One shouldn't ask what DOD should do either. One should ask what should PHS do. A robotics program to develop a companion surrogate for the elderly, the infirm, and the handicapped would have a profound effect on long term care, both as to cost and to quality of life.

Just think the irony of going over to Sony, having them take my video, Technology Justification, put it on their jumbo screen, and have me talk to 500 of their executives. Then, to have them say that we think there's a potential for this robot technology to take care of our aging citizens.

My closing line here is, as the song goes, we had it all. We don't have it all in the industrial arena anymore, but we still have it, from the point of view of technology. It's just up to us to exploit it.

Thank you.

[The prepared statement of Mr. Engleberger follows:]

U.S. INNOVATION IN ROBOTICS AND JAPANESE EXPLOITATION

The industrial robot was born in the USA. We developed the technology and the applications. Today Japan owns the industry. At a level of three billion dollars plus annually, two thirds are produced in Japan. The per capita density in Japan is seven fold that in the USA.

American giant corporations as General Electric, Westinghouse, IBM, AT&T and United Technology treated robotics as a commodity, dumped to get market share, abandoned R&D and then in disenchantment liquidated, leaving the entrepreneurial start-ups in chaos.

Japanese companies took the long view, nurtured the technology and their customers, first building a domestic base and then fanning out globally.

From the beginning United States research and development were superior. Even today it is superior! Where we fail is in exploitation of our technology. The Japanese are the implementors, we remain the dilettantes.

What is so critical is the long view. In 25 trips to Japan meeting with executives of major corporations, I never had a discussion of payback, or discounted cash flow, or return on investment. It was always on performance, quality, reliability. The decision makers are engineers and manufacturing executives, not "bean counters" as in the USA.

In 1967, I flew to Japan as the guest of the government. After being royally entertained for a week, I spoke to 500 Japanese executives in Tokyo about robotics. Their enthusiasm kept me on the dias for 4½ hours!

Senior Japanese corporate executives lent their names and time; and, JIRA, the Japanese Industrial Robot Association, was formed three years before we in the USA formed a feeble RIA, Robotic Industries Association. The same U.S. corporations who later brutalized our embryo industry would provide no support in the formative years, be it finance or merely endorsement.

Now, robotics offers a new frontier with a much grander outlook than the factory floor. I speak of robotics in service applications. Increasing productivity in service jobs is also a way to improve competitiveness. The products themselves represent a multi-billion dollar manufacturing opportunity. Applications ranging from commercial cleaning to personal care for the elderly greatly exceed factory roles.

My book, *Robotics in Service*, MIT Press, is offered in evidence.

We in the USA field a scrawny organization the NSRA, National Service Robot Association. And, once again the U.S. has the best technology, the best vision of the prospects.

Bearing the mantle, "Father of Robotics," I have been making the rounds among the logical U.S. corporations to find a sponsor. We are written up by Forbes and Barron's. Television exposure is great. All to little avail.

Ah, but the deja vu! In February 1991, yet again I was invited to Japan. The title for my lecture was chosen by my hosts, "Robots and Humans, Shoulder to Shoulder". Japanese companies are seeing the potential of which I speak. I wager my long sought support will come from Japan; unless at their current level of confidence they just elect to soak up what we have published and bypass the U.S. entirely.

And, what about U.S. government agencies? NASA has a Flight Telerobotic Servicer, FTS, program that has grown from $90 million to $800 million on the weakest justification while the United States Postal Service cannot budget a $1 million project to develop a washroom cleaning robot with profound terrestrial market potential.

NASA has the arrogance to project domestic fallout from their fantastically expensive space hardware which is ill-conceived even for its intended use.

Do not ask what DOD should do. Ask what PHS should do. A robotics program to develop a companion-servant for the elderly, the infirm and the handicapped would have a profound effect on long-term care, both as to cost and as to quality of life.

Oh, the irony of having Sony, the preeminent purveyor of entertainment, see the commercial potential for personal robots in support of their senior citizens. How nice of them to let me use their giant Jumbo-tron™ to screen my technology video for hundreds of their executives!

As the song goes, "We had it all, just like....".

Joseph F. Engelberger
Chairman
Transitions Research Corporation
9 May 1991

Mr. Valentine. Thank you, sir.
Dr. Kegg?

STATEMENT OF DR. RICHARD KEGG, CINCINNATI MILACRON, CINCINNATI, OHIO

Dr. Kegg. Mr. Chairman, committee members, and guests, the written instruction which you provided your witnesses, brought to our attention some very heavy issues which require deep thought. We've responded to that in writing.

However, your staffer, Bob Schunemann, provided me with a Form 1040EZ. He gave me an oral summary, in his own words, of what he would like to see me present today. I will address those issues orally which are very intimately interwoven with the more complex issues. Bob said, "How did we get into this mess? What does the machine tool industry have to do with it? And, what can be done to fix the problems?"

I'd like to address those three points briefly.

First, I'll give a little bit of a lecture on Japan. I apologize for this, we've all heard too many of them, but it can't be done without a little bit of a lecture on Japan. I'm not a professor of oriental studies, but a person who is a fighter for his own business and company. I believe in knowing the enemy. Therefore, I have spent 30 years learning about the Japanese, visiting them, as Joe has, studying their language, studying their people, lectured many times, and been lectured to many times. I have scarfed down pounds and pounds of raw fish washed down by lots of sake and beer in the Japanese fashion.

How did we get into this mess? As Japan recovered from the war, the Japanese government consistently and pervasively took actions to hold down the value of the yen. They did this in many, many ways, significantly, by holding down the wages of the Japanese workforce, by holding down consumerism in the country, and by encouraging thrift among individuals and government. With the yen at 250 or 300 to the dollar, the Japanese machine tool or other company could export product to the United States, discount it 30 percent from what he sold it for in Japan, and still make profits three to five times as much as he would make selling the product at home, purely by currency translation. He could make these huge profits in spite of some of the well known inefficiencies in Japanese industry. In spite of these, they made very, very great profits. This went on for a long time. With a 30 percent reduction, or something similar, the Japanese got all the orders. In spite, they made very great profits. Rounds one, two, and three went to the Japanese government in our fight.

Next, there was a great stampede to export to the United States. Every Japanese company wanted to do this because it was more profitable than their own market because of currency translation. To avoid unnecessary corporate bloodshed, MITI stepped in and brought order to the export marketplace in their own inimitable way. Round four to the Japanese government.

Next came, as a result of prosperity, the start of the long term thinking myth of Japanese industry. Public corporations were making so much profit that they said to each other, how can we keep from drawing so much attention to the profitability of what we're doing? Let's invest in things which cost money today which will pay back in the long term. As a result, they invested in superb manufacturing equipment, new, efficient factories, human resources training, and programs to improve quality and productivity. Their cost today, subtracted from the bottom line, put money in the bank for tomorrow. Round 5 went to Japanese industry for having the right instincts in what to do in that situation.

The Japanese worker, with his great education and loyalty to the group, responded very well to these programs and helped greatly to improve quality and productivity. Round six went to the Japanese workforce.

The United States finally got our legs under us a little bit. The previous Administration and Government jawboned the Japanese government into relaxing the fiscal policy and letting the yen adjust. At 135 to 150 to the dollar, American manufacturers can win in the marketplace. We have the product, the quality, and the productivity. I, personally, have fought the battle and won. These programs take time and U.S. industry needs to address them. Round seven went to the U.S. Government.

Today we are in round eight of a 10-rounder. We, in industry, have to carry the rifles into the trenches. We will appreciate what help we can get. This is how we got here.

What does the machine tool industry have to do with it? This is a small, small industry. The total economic worth of the machine tool industry has been compared to frivolous, potato chip advertising budgets. It is a small industry that has tremendous leverage on the U.S. economy.

The machine tool industry has a very great strategic importance in defense. In the recent Gulf War, all of the large cannons that fired shells had been made on Cincinnati Milacron special machine tools. All of the Bradley fighting vehicles that performed well had their chassis machined on Cincinnati Milacron special machine tools. All of the battle tanks had their hulls machined and other components machined on Cincinnati Milacron special equipment. All of the major airplane structures had components which were machined on key Cincinnati Milacron special equipment. The carbon fiber skins of the Stealth aircraft were made on Cincinnati Milacron special equipment. This is the strategic value of the machine tool industry.

We also have a strategic commercial value. In the commercial airplane industry, special machine manufacturers in the United States prosper with prosperous commercial airplane manufacturers. We help them. When we succeed, they succeed, and when they succeed, we succeed. Boeing exports a tremendous amount of airplanes, we export a tremendous amount of machine tools to make airplanes in other countries. I might say that technology goes there a few years after Boeing has exploited it. This is the importance of the machine tool industry.

What can be done? We all know what can be done. The U.S. industry has to develop good products that are competitive worldwide. We have to develop good factories which are productive of the quality and productivity. We have to sell better. If we do this, we can beat our competition at today's value of the yen. I guarantee you that we, in the machine tool industry and Cincinnati Milacron, will fight the good fight. You can count on this.

Can you help? Yes, you can. You can help in the 9th and 10th rounds of the fight that we're in today. You can help with VRA continuation. You can help with a continuation of the Buy American Policy among all government procurements of machine tools. You can help with investment tax credits, if this is a viable thing within the system. In this fight you can help.

In the next fight to come, for those who survive, you can help with the research of NIST, with the research and development of Mantech programs, and with NCMS. All of these can help us, but let's remember very clearly the difference between today's fight and the next fight. We have to survive today's fight in order to get the benefits of the research and development.

You can count on Cincinnati Milacron to do what we can. We have benefitted from Government programs in the past. We believe we can count on you to help us help ourselves.

Thank you.

[The prepared statement of Dr. Kegg follows:]

Testimony to the

U.S. House of Representatives
Committee on Science, Space and Technology
Subcommittee on Technology and Competitiveness

by

CINCINNATI
MILACRON

Dr. Richard Kegg
Director of Technology and Manufacturing Development

Washington DC
May 9, 1991

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I. Background on Cincinnati Milacron

Cincinnati Milacron is the largest U.S. builder of metalcutting machine tools and plastics-processing machinery. The company was founded in 1884 and has been publicly traded since 1946. In 1990 we had total sales of $838 million.

Milacron is an international company, with headquarters in Cincinnati. We have ten plants in southwest Ohio and factories in four other states as well. We have major manufacturing facilities in England and Austria, with some smaller operations in France and the Netherlands. Close to 15% of our U.S.-made products are exported, and about 30% of our total sales are to countries outside the U.S.

The past decade has been very difficult for machine tool builders. To be blunt, the manufacturing sector of the U.S. economy did not participate in the economic recovery and prosperity of the 1980s. In fact, it can be argued that the manufacturing base in the U.S. has deteriorated significantly in the last ten years, and manufacturers are the customers of machine tools. In addition, we face intense foreign competition in both export and domestic markets.

During these tough times, Milacron has not been standing idly by. We have undertaken two major restructurings. More than simple downsizing efforts, these reorganizations included major programs for modernization, cost-reduction, efficiency and quality. We've also divested most of our "peripheral" businesses in order to concentrate on our core technologies: metalworking and plastics processing. Despite low profits, we've not skimped on R&D. In the past ten years, we've spent almost $350 million on research, averaging over 4% of sales.

Cincinnati Milacron has long had a worldwide reputation for advanced technology. Currently, however, not all of our products are price competitive, especially vis-a-vis foreign tool makers. As a result, we have launched an ambitious new-product development effort, whereby all our product lines will be redesigned, expanded and replaced with state-of-the-art, low-cost, all-metric products. This effort to make Milacron world-competitive, which we call our Wolfpack program, will cost us in the neighborhood of $200 million over a five-year period.

Milacron is at the forefront of many important technologies, including two of the three key areas identified by this subcommittee: machine tools and manufacturing. The category "manufacturing" obviously covers a variety of technological disciplines. Slicing the pie a different way, the White House recently issued a list of 22 areas of technological development that should be nurtured as "critical to the national prosperity and to national security." Milacron is heavily involved in seven of them: materials processing, composites, high-performance metals and alloys, flexible computer integrated manufacturing, intelligent processing equipment, systems-management technologies and software.

II. The Importance of Machine Tools and Related Technologies

[This addresses issue #6 in the Hearing Charter.]

It's difficult to overestimate the importance of machine tool and related manufacturing technologies to our country. The military or strategic significance is clear. In order to make high-tech weapons, aircraft and other military vehicles, we must have high-tech manufacturing equipment and systems, including machine tools. Put another way: we cannot be militarily independent if we depend on foreign-built tools to make our military equipment.

The economic importance of machine tools often goes unrecognized because it's such a small industry in and of itself: perhaps $5 billion in the U.S. and $50 billion worldwide. However, it is widely recognized that the health of our economy depends on a vibrant, productive manufacturing sector. Agricultural strength alone is not enough to keep up with the industrialized world economies. Furthermore, our best hope of balancing the trade deficit is through increased exports of manufactured goods. Machine tools, in turn, are central to manufacturing, and advanced machine tool technology is necessary to produce goods that are competitive on cost and quality. Therefore, from an economic point of view as well, machine tools are a critical technology.

III. Status Report on the U.S. Machine Tool Industry

There are serious concerns about the health of our manufacturing base in general and of our machine tool industry in particular. As previously mentioned, the manufacturing sector did not fully participate in the economic recovery of the 1980s. Much of our manufacturing activity moved offshore and has stayed there. Manufacturers are the buyers of machine tools, so our customer base has shrunk. At the same time, foreign competition in machine tools, in both domestic and overseas markets, has been strong and is gaining.

The U.S. has become a much smaller player in the machine tool business worldwide. We consume less than 10% of the world's machine tools, compared to 25% to 30% two decades ago. Japan consumes three or four times the machine tools as we do; and West Germany twice as much. Also, we've fallen to sixth among world producers of machine tools, well behind Japan and Germany and probably the U.S.S.R. Many old-line U.S. machine tool companies have gone out of business in the past decade and, while there was a modest rebound in the late 80s, most of the surviving companies are marginally profitable at best.

The one bright spot or exception is advanced machine tools for the aerospace industry. Here the U.S. takes a back seat to no one. We are world leaders in aircraft manufacturing and as builders of advanced equipment for aircraft manufacturing. [Milacron, by the way, is a leader in this end of the business: machine tools and composites processing equipment for use in making structural aircraft components and jet engines.] The benefits of a successful aerospace industry extend to our entire economy in the form of high-paying jobs, technological spin-offs and high levels of exports.

IV. Government and the Machine Tool Industry

[This addresses issues #1, 2 and 5.]

Generally, most of our problems in the machine tool industry stem from a lack of profitability. This is our own responsibility. It is up to government, however, to help create the legal and political climate wherein we can regain our profitability. There are several political and/or legislative issues affecting this climate. Briefly, without going into the whys and wherefores, Cincinnati Milacron favors the following:

1. Extension of the Voluntary Restraint Agreements (VRAs) with Japan for imported machine tools, until the U.S. machine tool industry has regained stability and profitability.

2. Extension of the Buy American Act, restricting DoD purchases to maintain our strategic manufacturing technologies.

3. Reform of our product liability laws, which have no statutes of limitations and no caps on awards. Only U.S. companies labor under such costly handicaps.

4. Reform of our export controls, which unduly restrict U.S. companies vying against foreign competitors.

5. Revision of the tax code. The 1986 revision took away the investment tax credit and other incentives to invest in capital equipment.

V. Specific Government Actions in Three Areas

[This addresses issues #3, 4 and 5.]

A. Standards

The promotion and development of consistent meaningful standards is a logical area for government initiative. We are hampered by standards and codes that vary from state to state and are very different from international standards. Our JIC system, for example, is incompatible with Germany's DIN specs.

Efforts in the private sector to develop "universal" standards have not been successful. Milacron participated in General Motors' much publicized program to establish factory automation standards (M.A.P., for Manufacturing Automation Protocol) and, despite years of effort by scores of companies, it failed. The European Economic Community is currently developing pre-standards, and the U.S. should be involved. It will require government leadership and international cooperation, but common standards would benefit everyone in the long run. They're needed in many areas: electronics, computer controls, hydraulics, and so on, to name just a few.

B. Research and Development

It's important to realize and recognize that, in the machine tool business, U.S. firms are competing against Asian and European companies whose R&D has, to a significant extent, been government subsidized. U.S. companies enjoy some government sponsored R&D via military and space programs. When new manufacturing technology is developed in this fashion, it can and should be a benefit to everyone. The key here is to concentrate on dual purpose technologies, i.e. technologies for military production that translate easily into commercial use. This gives us a multiplier effect on the cost-savings or payback.

Milacron participates in many government sponsored programs, such as Mantech, NCMS, DARPA, and so on. We believe defense spending cutbacks should not be applied to these programs since they can and usually do pay for themselves many times over. In short, we view the "peace dividend" as an opportunity to concentrate on developing broad-based, multi-purpose manufacturing technologies so that, as the cliche goes, after winning the war we can also win the peace.

So, while we're in favor of such programs, we would be remiss if we didn't offer our honest criticism of them.

In our opinion, too much military R&D money goes directly to the big defense contractors, who are users not providers of manufacturing technology. As users, they have no incentive to transfer the newly developed technology because that would be sharing with their competitors. If machinery makers (such as Cincinnati Milacron, we admit) and other providers were to receive R&D money, breakthroughs in manufacturing would be made available throughout industry because it is our business to transfer technology to our customers.

We also believe that participation in government programs is more expensive and time consuming than it should be. There is a lack of communication and coordination among them, which necessitates a lot of staff hours just to keep up on which programs exist and what they're doing. Then, to top it off, some programs ask for $100,000 or $200,000 participation fees. At Milacron, we have difficulty keeping up and it's hard to imagine how smaller companies could afford to do it.

Finally, some government R&D programs have a horizon that's just too long or far out. For example, the effort to help develop the next-generation computer control. If it takes more than a few years, it will be outdated before it's delivered.

C. Education and Training

In the U.S., the quality of university research in the area of manufacturing science is poor. And that's because it is done with a pencil and paper, in an office, at a desk, and not on the shop floor or in a lab with machinery. Essential to all scientific discovery are observation and measurement, neither of which can be done theoretically. Furthermore, manufacturing engineering, more than any other type of engineering, requires hands-on experience. The Germans and the Japanese understand this, and their researchers get their hands dirty working with machines and processing parts.

Government could help improve our university R&D by channeling existing funds into a new approach which would focus industry-university partnership. This might include:

1. Programs aimed at getting technical and/or managerial people from industry -- active or retired -- to teach and lead R&D efforts at the university.

2. Programs granting professors and university researchers sabbaticals to spend time working for industry in real-life settings.

3. Programs to get state-of-the-art machine tools and other manufacturing equipment into university laboratories.

4. Programs sponsoring joint industry-university R&D.

Beyond research, we see two major challenges facing education and manufacturing today:

1. Developing a curriculum that balances technical and engineering disciplines with business and managerial skills.

2. Attracting more bright young students to follow this course of studies and pursue careers in manufacturing.

Universities, industry and government should work together to develop and promote a special MBA/Engineering degree program. Funds should be made available in the form of loans and/or scholarships as incentives to pursue such a degree.

As far as blue collar or skilled trades training is concerned, we in industry need all the help we can get. Cincinnati Milacron is a telling example. For many decades we ran one of the largest (if not the world's largest) apprentice training schools for machinists. Thousands of workers went through our program, as we trained machinists not just for Milacron but for the entire industry. Unfortunately, in the early 80s we had to close down our training school. It was just too expensive to maintain during prolonged difficult times.

In closing, we at Milacron would like to extend to this subcommittee the same offer that we've made to the Armed Services Committee of the Senate. We propose to help sponsor a joint government-industry-university seminar on the funding of education and R&D programs. It would facilitate communication and coordination among the many agencies and programs that already exist and help identify new initiatives that should be taken.

Mr. VALENTINE. Thank you, Dr. Kegg.
Dr. Mettler?

STATEMENT OF DR. RUBEN F. METTLER, RETIRED CHAIRMAN AND CEO TRW, INC., WASHINGTON, D.C.

Dr. METTLER. Mr. Chairman, I have submitted a statement and as it stands, I think my best contribution to your hearing is to focus on the first item you had identified in the hearing material, which was the developing of a national strategy, policy, or vision, and moving critical manufacturing technologies from lists out to reality. The statement covers a number of points that are relevant to that subject.

In the interest of time, I think I will just focus my comments on one of those categories. Simply put, it is that over the years we have developed, in this country, domestic policies that are largely tailored around our domestic concern without giving much weight to competitiveness or to the international effect of these policies. I think it's necessary, at home, to change and be willing to change many of our domestic policies and practices, both public and private. We need to get a balance of the realities of international competition. The task, I think, is to make politically and economically feasible what is competitively necessary.

Focusing my comments on domestic policies, I don't want to downgrade the importance of trade issues. I do believe that most of our competitive weaknesses are homegrown and are correctable at home. It should be easier for us to change our own policies and practices than those of foreign leaders and foreign publics.

What I'd like to do is identify and use a few examples that illustrate how our domestic practices, laws and regulations conflict with competitiveness. For a variety of reasons, largely centered here at home, current U.S. fiscal and regulatory policies result in substantial financial penalties for U.S. companies compared to foreign competitors, not only overseas, but home markets also.

To take an example, visualize, for a moment, two identical, new manufacturing plants. Both are located in the United States. One is owned by an American company. One is owned by a foreign company. Both companies are globally active. To focus on the financial variable, not that they are the only thing that's important, assume that everything inside the two facilities is identical. They have the same level of investment, the same products, the same workforce, the same internal organization, and the same productivity. Everything is identical. Both plants are subject to U.S. tax policies. If you take those two plants and make the assumption that they had $100 million invested in each, the result is, applying our own tax policy to the two plants, that the U.S. owned facility will have a significant competitive disadvantage on the day it opened. A disadvantage that will grow and become more serious year by year. The same tax provision has the effect of creating a tax benefit for the U.S. owned corporation to move its R&D to a foreign country. That is hardly something that we want.

Another example, the New York Federal Reserve Bank, in one of the best studies of international cost of capital differences, has estimated that each year from 1976 to 1988, the after tax effects of U.S. tax, regulatory, and financial policies—

Mr. **Valentine**. Doctor, excuse me.

Dr. **Mettler**. Yes?

Mr. **Valentine**. We want to hear this. Could you-

Dr. **Mettler**. Can you hear me now?

Mr. **Valentine**. We were straining a bit and we don't want to miss any of this.

Dr. **Mettler**. I hope you heard that example because I think this is a rather startling one.

Let me continue on.

Mr. **Valentine**. If you would back up a few sentences, it will make sure that all of us have a chance to take this in.

We were straining a bit there.

Dr. **Mettler**. I was using as an example, the two identical plants.

Mr. **Valentine**. Yes, same investment.

Dr. **Mettler**. They have the same investment, same internal operations, everything identical except one is owned by an American company and one is owned by a foreign company. Both of those plants are subject to U.S. tax policy. The tax policies are applied. The result of that is that the U.S. owned plant is at a significant competitive disadvantage on the day it opens. A disadvantage that gets worse and accumulates year by year. That same section of the tax code provides a benefit to U.S. corporations if they move their R&D overseas. My argument is that is hardly what we want. That is an example of something that grew up in our own domestic environment that is clearly disadvantageous to American companies even in the United States.

The next example that I was starting on was the cost of capital. It is a very important critical determinant of investment levels and the kinds of investments that can be made. The New York Federal Reserve Bank has done, what I think is, one of the very best studies of that issue. It estimates, for each year from 1976 to 1988, that 12 year period, the effects of U.S. tax, regulatory, and financial policies on specific projects. The three projects that they highlighted were ten year R&D projects with a long term payoff, equipment machinery with a useful life of 20 years, and equipment with a useful life of 3 years. In each case, the cost of capital for U.S. investors is dramatically higher, in each of the 12 years studied, than for foreign competitors from Japan or Germany. Not just a few percent higher, but over twice as high for a 10 year R&D project when compared with Japan. These large differences compounded over a decade have a very strong effect on the behavior, flexibility, and competitiveness of the various U.S. companies that are carrying the front line role in our economic growth and competitiveness. Particularly, in regards to size and time horizons of investment.

I will give a third example. Despite the importance, significance, and focus on manufacture, the research and experimentation tax credit, as currently defined, includes very little of the advanced manufacturing technology identified in the Critical Technologies study. Here's an example where that already existing provision could be made applicable to manufacturing.

In my statement, I have some other material. I comment on the two recent reports, one the Critical Technologies Report by the panel appointed by the OSTP, and the other the recent report of the Council on Competitiveness. I think it is an excellent report that gives specific recommendations for leadership, development in government, private industry, and universities as steps that should be taken. I strongly endorse those recommendations and urge that the subcommittee follow up on them and study them very carefully.

Thank you.

[The prepared statement of Dr. Mettler follows:]

TESTIMONY TO SUBCOMMITTEE ON TECHNOLOGY AND COMPETITITIVESS

MAY 9, 1991

RUBEN F. METTLER
RETIRED CHAIRMAN AND CHIEF EXECUTIVE OFFICER
TRW., INC.

Mr. Chairman, and Members of the Subcommittee.

I appreciate the opportunity to participate in your hearing this morning. Understanding the strong linkages between technology and competitiveness and economic growth, and then promoting action as needed to effectively restore our leadership position in critical technologies is a task vital to our nation's well-being.

As you can see from the biographical information I provided, I recently retired from the position of Chairman and CEO of TRW, Inc. Most of my adult experience has been at the intersection of three broad fields: science and technology; corporate management and business-government relationships; and national security; and I will speak from that perspective.

I believe I can best contribute to your deliberations by focusing on the first issue identified for the hearing - developing a national strategy, policy, or vision for moving critical manufacturing technologies from lists to reality.

I recently presented a paper on U.S. Manufacturing in a Global Context at a national meeting of the National Academy of Engineering, and with your permission I'd like to enter the paper into the record, and then comment on its key points in this statement before responding to questions.

The paper discussed four topics:

The global challenge to our economic growth and competitive position; and

Why manufacturing excellence deserves high priority attention; and

The need to identify and resolve the conflicts between the reality of global competition and both public and private policies and practices developed primarily in a domestic context; and

Leadership and strategy for economic growth and competitiveness.

The Competitive Challenge

We Americans face a major challenge to our national will and national capacity--a challenge that is not receiving the priority it deserves--a challenge that will be one of our dominant economic issues for the rest of this century and into the next.

I speak of our imperative need to rebuild and maintain our competitive position in the global marketplace, as an essential step in achieving strong, non-inflationary growth, high levels of employment, and a rising standard of living for a growing population.

The challenge to our economic growth and competitiveness is closely linked to another major challenge we face--maintaining our national security and preserving our social and political values.

How well and how quickly we restore and/or maintain our position as world-class competitors in strategic industries will largely determine our ability to meet our national security and foreign policy goals as well as realize our domestic social, political, and economic aspirations. World-class excellence in manufacturing will be a central requirement.

We might ask--with the stakes so high--why are we experiencing a serious erosion of our competitive position in a number of strategic industries? Why aren't we reversing the trend? We have so many strengths--the largest economy and industrial capacity in the world, the biggest marketing networks, science and technology that lead the world in scope and depth, excellent universities, and a work force that is one of the best educated and most skilled.

So what's the problem? What's going on? Are we doing enough? Are we headed in the right direction?

While I do not wish to be overly optimistic, I do believe that we are getting closer to understanding the steps necessary to stop the erosion of our competitive position in domestic and international markets.

The evidence of the erosion of our competitive position has been so wide-spread and compelling in recent years, that there has been an avalanche of private and government studies and reports making relevant observations and recommendations related to U.S. competitiveness.

Two of the most recent reports are especially noteworthy. The critical technologies report from the National Critical Technologies Panel appointed by the OSTP both supports and integrates the many other private and government critical technology studies and confirms that we have a substantial consensus on technological priorities. "Gaining New Ground" a recent report of the Council on Competitiveness identified many of the same critical technologies and makes specific recommendation for actions by government, industry, and universities. The Council's report also identified additional high priority issues requiring attention -- that is, education and training at all levels; and macro-economic issues, particularly those that most directly affect U.S. investment in physical and human capital and research and development.

The challenge now is to make the transition from analysis to leadership and action in industry, government, and education and professional organizations.

Why Manufacturing?

In this broad context, why does manufacturing deserve priority attention among the many functions in which we must achieve world-class excellence?

The reasons are many and persuasive.

Manufacturing technology, broadly defined, is identified in all of the reports on critical technologies as one of the basic building blocks for virtually all sectors of the economy, and there is ample evidence that we are falling behind the best of our foreign competitors in manufacturing performance.

Manufacturing excellence is central to our competitive position in global markets for both products and services. Product and service markets are largely inseparable and mutually supporting. We cannot be a world leader in either without being a leader in both.

We have suffered a significant loss of global and domestic market share in a number of key manufacturing and service industries, both in primary products and supporting production equipment. These industries range from semi-conductors and automotive vehicles to banking and financial services. Fortunately, some U.S. industries have maintained their domestic and global position. These include defense, aviation, agriculture, petro-chemicals, and health-care. We should understand why these are different.

We must learn from and catch up to certain foreign competitors who have in recent decades developed new manufacturing and product development concepts in certain industries (electronics and automotive, for example), that are demonstrably superior to ours in the U.S. with respect to quality, cost, time to market, and product diversity.

Technological change is the major driver of economic growth, and it has its highest leverage when it results from innovation which combines product design and manufacturing process.

Our massive trade and current account deficits can only be reversed by significantly improving our trade balance for manufactured products. Trade in services, tourism, and other factors is simply too small.

Key foreign competitors have been investing at higher levels than U.S. companies in non-defense R and D and manufacturing technology, defined broadly. In addition, they benefit from a significantly lower cost of capital, which has particular competitive leverage in capital intensive manufacturing industries.

Real wages of the manufacturing work force have stagnated, and there has been a significant loss of employment opportunities.

There is much work to be done to improve the quality of training and proficiency of our manufacturing work force, and to focus on advanced manufacturing engineering and manufacturing management at American universities.

There are significant risks in becoming critically dependent on foreign suppliers for national security systems, without assured timely access in times of stress in military or economic affairs. This relates closely to the erosion of our technological and industrial base for both defense and commercial purposes.

And the list could go on.

So manufacturing really matters -- and it does deserve special attention.

Nature of Global Competitiveness

The primary responsibility for competitiveness in domestic and in international markets rests with U.S. business. However, the policies and actions of government and of educational and professional institutions have a powerful influence on the ability of business to function effectively, and it is their responsibility to develop and maintain an environment that provides for effective competition and facilitates the performance of all U.S. institutions, both private and public.

Winning or losing in world markets depends on the entire fabric of policies and practices, private and public, at many levels and in all parts of our society. These include:

- management and strategy in large and small companies;
- education and training;
- savings and investment levels;
- tax policies and cost of capital;
- strong financial institutions;
- trade policies and market access;
- science and technology;
- product and manufacturing innovation;
- quality and productivity;
- marketing and distribution;
- public/private cooperation;
- and most particularly, leadership and strategy from to bottom.

In any particular competitive situation, the effects of some of these factors will be critical, direct, and immediate, and in others indirect and longer range. But eventually they are all expressed at the level of product against product, service against service, and company against company. In an intensely competitive environment small differences of advantage or dis-advantage are often the margin between winning and losing a particular competitive race, and large differences, if sustained over time, can be disastrous to an entire industry.

And today, our domestic economic health and vigor have become increasingly dependent upon global markets. Although our economy is the world's largest, it has increasingly become a shrinking fraction of something bigger and stronger--an integrated world economy. We must understand the implications of this change. And we must deal with it.

Setting world-class standards and measuring ourselves relative to world-class competitors is a starting point. In this regard, there is a tendency to take far too much comfort from our own domestic improvements, even while falling further behind foreign competitors who are improving even faster.

Domestic/Global Conflicts

An especially critical task is developing a better understanding of where and how our domestic policies and practices - public and private - conflict with our competitiveness in global markets. Policies and programs and regulations tailored to specific domestic concerns and developed over many years without enough weight given to international effects, often have significant negative effects on our competitive position.

State more strongly: We must accept the need to change domestic policies and practices - public and private - where needed to strike a balance with the realities of world-class competition.

The task is to make politically and economically feasible what is competitively necessary.

A key requirement is to integrate our thinking about technology policy and economic policy. Investment levels, tax policies, cost of capital, etc. are major considerations in technology policy. And research and development and strategic technologies, particularly those with a strong impact on many industries and promising high growth, are major considerations in economic policy, Indeed, most of economic growth in recent decades has been attributable to technological change in both manufactured products and in services. Some industries have higher leverage on growth than others, and the _composition_ of national output is a major consideration in achieving economic growth and competitiveness.

By focusing in these remarks on domestic policies I do not want to downgrade the importance of trade policy and the continuing battle for market access in foreign countries and for more comprehensive multi-lateral trading rules. For example, we are far from having equal market access in many nations, and failure to consummate a successful Uruguay Round would be a serious set back.

But I believe that many - perhaps most - of our competitive weaknesses are home-gown, and thus correctable at home. It should be easier for us to change our own policies and practices than those of foreign leaders and foreign publics.

There are many examples of conflicts between our domestic policies and the reality of global competition. I'd like to highlight several that illustrate the point.

Few competitive issues are as pervasive and important as investment levels in U.S. corporations for non-defense R and D and manufacturing productivity. And few have been as much discussed.

Yet, for a variety of domestic reasons, current U.S. fiscal and regulatory policies result in substantial financial penalties to U.S.

companies relative to foreign competitors not only overseas but in our home markets as well.

The New York Federal Reserve Bank, in one of the best studies of international cost-of-capital differences, has estimated, for each year from 1976 through 1988, the after-tax effects of U.S. tax, regulatory, and financial policies on specific projects - for example, a ten-year R and D project with a ten-year payoff tag, equipment and machinery with a useful life of 20 years, and expenses equipment with a useful life of 3 years.

In each case, the cost of capital for U.S. investors is dramatically higher in each of the 12 years studied than for investors in Japan or Germany - not just a few percent higher but over twice as high as compared with Japan for the 10-year R and D project.

Consider the impact of these differences, compounded for over a decade, on the behavior and flexibility and competitiveness of the very U.S. companies that are carrying the front-line role in our economic growth and competitiveness challenges.

Much attention has been focused on the short-term orientation of U.S. managers, and the resulting under-investment by U.S. corporation in long-term R and D, and manufacturing productivity. To a considerable extent this is simply a rational reaction to the higher cost of capital and the resulting needs to recover costs in a shorter time period and to earn higher profit margins.

As another example of domestic/global conflict, visualize for a moment two identical new manufacturing plants, both located in the United States, both owned by globally active corporations, one foreign and one U.S. To focus on financial variables, assume that everything inside these two facilities is the same -- level of investment, products, work force, internal organization and management, productivity, everything. Both plants are subject to U.S. tax policies (section 861). The result is that the U.S.-owned facility will have a significant competitive disadvantage on the day it opens, a disadvantage that will grow and become more serious year-by-year. These same tax provisions have the effect of creating a tax benefit if the U.S.-owned corporation moves its R and D to a foreign country.

One might imagine that these perverse effects would be easy to correct. Actually they have been debated in the Administration and Congress for years, with U.S. competitiveness losing most of the arguments.

Leadership and Strategy

In closing, I wish to briefly turn to the issues of leadership and strategy.

I'd suggest the following premises in thinking about leadership and strategy.

- The penalties to our national goals and aspirations, if we fail to reverse the trends in our competitiveness, particularly in key strategic industries, will be severe and long-lasting.
- Current trends are not acceptable. Coordinated aggressive broad-scope action in all sectors of our society is clearly needed.
- Strong, focused leadership and a coordinated nation-wide strategy are essential. A successful strategy must encompass the full range of interdependent factors and actions need in all segments of society. Special attention is required to understanding and resolving the conflicts between our domestic policies and the reality of global competition.

- Developing a winning strategy requires that we develop a shared understanding and vision of technology and manufacturing and their strategic significance in a global context.

- Competitiveness depends heavily on cumulative experience and requires a sustained long-term perspective and sustained actions. We are in a marathon, not an annual 100-year dash.

- We must set our performance standards and measure ourselves relative to world-class competitors. And we must learn from our most successful competitors - their challenge is intellectual as well as economic.

- Industry is directly responsible; However, government and educational institutions and other private groups have a vital role in developing an environment that provides for effective competition and facilitates the performance of U.S. institutions.

How do we get on with the necessary actions? How does our country develop a coordinated strategy for competitiveness? Where does the leadership come from?

The sources of leadership are many - in government, in industry, in universities, and in other private institutions A government command concept won't work, yet only government spans the full scope of the issues. No sector of our society can do it alone.

Leaders are only effective if there are followers. The followers are ready. I believe the key to generating leadership and strategy is in the large army of talented individuals and private and public organizations who are concerned about the issues, publishing studies and recommendation and prepared to participate in finding solutions. It is in all those studies, recommendations, and coalitions, all pressing for action.

The task is to put our system to work.

In this regard I subscribe to the five recommendations made by the Council on Competitiveness, augmented by vigorous actions on the parts of the total competitiveness agenda which their report did not address - education and training at all levels, and macro-economic issues, particularly those that most directly affect U.S. investment levels in physical and human capital, and research and development. I also endorse the OSTP critical technologies report, and especially its emphasis on manufacturing and process technologies, and its focus not only on hardware, but on software and systems, organization, and management and engineering practices as well.

Starting at the top, the President must be persuaded that it is politically and economically necessary for him to step forward and

- Establish technological leadership and world-class competitive performance as a national priority.

- Identify the benefits of success and the penalties of failure.

- Outline the elements of a coordinated strategy for success, and ask for wide spread help from the Congress and throughout the private sector.

- Emphasize the need for sustained, aggressive, broad-scope actions.

- Direct his Administration to give competitiveness higher priority across the full range of relevant policies and issues.

Related steps should be taken in the Congress, in private industry, in Universities, and in other private and government organizations.

We are all in it together.

Thank you, I'd be pleased to respond to questions.

Mr. LEWIS [ASSUMING CHAIR]. Thank you very much, gentlemen. This tremendous feeling of power I'm going to have may overwhelm me.

We're very fortunate to have people of your caliber come before our subcommittee and provide us with the information that you have.

I understand that, Dr. Mettler, you have to leave by 10:30. We've got about 20 minutes.

We have some questions for all of you.

Other that the lower interest rate, is that the major factor permitting certain other nations to have long term planning horizons? Are there other factors, such as tax treatment, profit depreciation and schedules, or vertically integrated businesses, which are more important?

Dr. METTLER. Is the question for me?

Mr. LEWIS. All three of you, I'd like for all three of you to comment.

Dr. METTLER. I can comment on that since I spoke to that study from the New York Federal Reserve.

Mr. LEWIS. Yes.

Dr. METTLER. The interest rates are an important component, but only one component. In understanding what the effect is on the investor, one must start with cost of funds, if you will, which go to interest rates, then apply the two to all of the tax and regulatory policies. It is really the after tax effect, faced by the investor, that is important. That is exactly what the Federal Reserve study has done. They have taken a specific project, like a R&D project that is extended over 10 years, and applied these policies to compare with the same precise situation in foreign countries. It is after all of these effects, like some of the ones that I described, which sound very strange, yet, there they are. In that particular case, it has been debated in recent years that Congress has been postponing the effect of some of those provisions, year by year. They are up again this year for an examination and renewal. That is the composite of everything as it affects the investor. In the end, it comes down to head to head, product against product, and company against company relative to specific competitors. Their circumstances and those of the U.S. manufacturer have to be compared directly at the bottom line.

Mr. LEWIS. How important are vertically integrated businesses?

Dr. METTLER. I think it depends on the industry.

In the electronics industry, the strongest Japanese electronics companies, for example, are vertically integrated. They have, in one corporate structure, everything ranging from materials and production equipment to semi conductors to electronic subsystems to huge systems within that vertical structure. They are very powerful competitors against many of the small electronic companies in the United States.

I think the total number of electronic companies in the U.S., is about 17,000. Over 16,000 have assets of less than $10 million. They are roughly the right numbers. We have at the bottom of that food chain, a large number of small American companies competing with a division of a giant. The result has been very tough for U.S. competitors.

Mr. LEWIS. Dr. Kegg or Mr. Engleberger, would you care to comment?

Dr. KEGG. This is not my area of expertise.

Vertical integration is not a significant factor in our industry.

Mr. ENGLEBERGER. I'd just like to say, as an entrepreneur who is not in the black with a new company, I had the chance to sell two previous companies to advantage. I had the chance in those companies to raise money a lot easier than it is today. I would say that if there are things done in the tax structure that makes investment in high tech start ups more attractive, that will benefit companies like my new company.

Thank you.

Mr. LEWIS. How about infant industry policy that gives start up companies a new industries favored treatment while they build a market share? What is your opinion on that, I'd like to ask all three of you?

Dr. METTLER. Go ahead.

Mr. ENGLEBERGER. To start with that would be nice after you've gotten past the original barrier and you have this infant industry going well. It would, then, be nice to have this additional opportunity to get an edge. I think our trouble in the United States, not just in my business but in a number of them, is getting to a critical mass in the first place long before you could be helped as an infant industry.

Mr. LEWIS. Dr. Mettler?

Dr. METTLER. I would add that I think there's no question, if one looks back over the last 20 years or so, particularly in Japan, the government policy of protecting industries when they are new and small and vulnerable and not allowing competition, or subsidizing them until they are big enough to be strong, has been a major part of their success relative to competitors.

That has been a subject of much discussion in the U.S.- Japanese negotiations. There is a lot of pressure for them to stop that practice. To some extent, it has because many of the corporations are big and strong. It is still a practice, one that for the very newest technologies, is a critical issue.

Dr. KEGG. I'd like to say that I believe that profitability of industry is key. If a climate can be created that makes it possible for companies to be profitable, they will take the long term view, they will spend money on research and development, and they will invest in their factories, productivity programs, and worker training. This has been done in the United States many times by many companies during good times. The key to having these companies seek their own way, for the survivors to do the right thing, is to create a climate that makes it possible for them to be profitable.

Mr. LEWIS. Dr. Mettler, I know you have to go and I have one last question for you.

Today, our business students are being taught to make decisions based upon opportunity costs and other short term principals when all of the industry leaders are saying that it is this same mentality that has killed us. Are there other short sighted and generally accepted concepts and views that we must change before we truly become competitive?

Dr. **Mettler**. First, I would say there are clearly many issues that deserve attention in their curricula. I'm happy to say that in recent years, after a rather long dry spell, there is a renewed interest and much stronger dedication in our universities, in the National Academy of Engineering and other groups, that are focusing on these issues. I think it's clear that there was a decline. If you go back to the 1950s or early 1960s, industrial engineering was a strong and vital curricula. It rather died out.

Manufacturing is a system. It's a mixture of supervision and employee relations, technology and plant layout, and purchasing. It's the whole enchilada. To train and to create a university curriculum that focuses on that is very difficult. I think progress is being made. I think there's no question that one needs a sharper focus on the nitty gritty, the specific facets of engineering and manufacturing. I'm happy to say that a lot of work, in that regard, is being done by the National Academy of Engineering and the universities to develop a whole new description for teaching manufacturing as a combined management and engineering discipline.

Mr. **Lewis**. Thank you, Dr. Mettler. We appreciate you attending this morning and providing us with your testimony and your insight.

I would like to point out to all three of you gentlemen, Mr. Engleberger and Dr. Kegg, don't run off, we do have a number of committee meetings going on this morning. We seem to be in an overload situation. Members may be coming in and out throughout this hearing process.

Dr. Mettler, thank you very much.

Dr. **Mettler**. Thank you and what you're doing, I think, is very important. Hang in there.

Mr. **Lewis**. Mr. Engleberger, in your opinion, is the U.S. ahead or behind of the Japanese in flexible computer integrated manufacturing processes? How do we compare with Europe?

Mr. **Engleberger**. If you use computer integrated manufacturing, I sure would want to defer to Dr. Kegg. If you want to talk about the technology of robotics in any and all phases, let me say that it's important for everyone to understand that this country has the best people and the best work when it comes to the research and development effort in robotics, both the hardware, the software, and the sensors, there's no question that we're ahead.

The terrible thing is that we publish it and we do nothing with it. I don't know how that works out in the computer integrated manufacturing business but I think you would be much more able to talk to that.

Dr. **Kegg**. Joe, you are a good straight man for me.

Mr. **Lewis**. I have one here for you on robotics, Mr. Engleberger. I'm not letting you off the hook that easily.

Dr. **Kegg**. A fact, computer integrated manufacturing was invented and developed in the United States of America. Our company, in the mid 1970s, developed computer controlled factories. Aerospace companies in the United States, working closely with U.S. machine tool and computer companies, developed computer integrated manufacturing very early in the late 1970s and early 1980s. U.S. machine tool companies and systems integrators took this product, perfected it and offered it for sale. Later on, Japanese and German companies did the same.

To our chagrin, the German and Japanese industry bought the product in great numbers and the United States companies did not buy the product in great numbers. In the knowledge of the technology and the development of the technology, I would say that the United States is a clear leader. In the implementation of the technology, our industrial competitors have gotten us again.

Mr. LEWIS. Mr. Engleberger, in the balance of developed technologies, the OSTP report, equipment suppliers in the United States are losing market share to international competition in a broad range of fields including fabrication equipment, machine tool controllers, semiconductor manufacturing, test equipment, and live scale presses. Do you agree with that?

Mr. ENGLEBERGER. I guess I can say that I do agree, but not from my personal experience. From everything I know about the industry, everything I read, all of those statements seem true to me.

Mr. LEWIS. Do you feel that it is too late to attempt a revival of the United States robotics industry?

Mr. ENGLEBERGER. Not at all, I have a particular segment that I have been concentrating on from a R&D point of view, which says that robotics in service applications represent a tremendously bigger opportunity than the entire factory operation. As a product, it represents a big business opportunity for someone.

If you look at what is going on at Carnegie-Mellon, Yale, MIT, Stanford, our universities, and some industrial labs, you'll find that we have all of the best technology to do something about it, but we're not doing anything. There aren't any of the large companies who should be in this field willing to do something. As I say, I have gone to many very large companies and I can tell you that when you tell someone that this is a three year development, his eyes glaze over.

If I go to Japan, on the other hand, chances are that's where I am going to get my support. It's sad that I can't find the support for the kinds of things we could do. If you make a robot for service activities, it will be mobile, sensate and have lots of capabilities which will enable us to go back in and have a strong position again on the industrial side. Most robots in industry are deaf, dumb, and blind. They won't be in the service area. I think that would give renaissance to the industrial side as well.

Mr. LEWIS. Dr Kegg, what do you see as the long term viability of the machine tool industry?

Dr. KEGG. The machine tool industry of an industrial country is linked inevitably to the manufacturing industries of that country. I see, in the United States machine tool industry, tremendous world class dominant strength in the manufacture of aircraft. I see us exporting machine tool technology after a brief advantage period for our domestic industry to all of the foreign countries which wish to make aircraft. To Greece, to Spain, to Italy, to Indonesia, to Korea, to every country around the world that wants to make aircraft, American machine tools are exported because they are the best.

They are better technology than the customer can get anywhere else in the world. This is because the domestic airplane industry is dominant internationally. The domestic machine tool industry and its customer airplane industry feed each other feed on each other's strengths. In other areas, where our domestic industry is weak, the machine tool industry suffers as well.

Mr. LEWIS. Ms. Horn?

Ms. HORN. Thank you.

I did duck out for a few minutes, so if this has been covered, I can read it in the record.

Mr. Engleberger, you mentioned the continued development that is needed on the service robot, a three year time line, and visiting companies to no avail. What would your estimate of the cost of development of getting a product?

Mr. ENGLEBERGER. I can give you a couple of examples because in the service area, there are 20 or so opportunities, like the one I spoke of for the United States Post Office. The first phase study was $130,000. There was great enthusiasm but they don't have the funding to do a washroom cleaning robot for $1 million. That's a robot that would go into a washroom and clean the toilet bowls, the sinks, the walls, and all of the unpleasant parts of that work. That's just the Post Office requirement. There are many of these. In fact today, I went to the washroom here and said what an ideal washroom you have here for robot cleaning.

Also, if I go beyond that and say that giving a robot which is mobile sensate with two hands, hand to hand coordination, things that are technically on, that would be like a personal servant. It's about a $15 million, three year effort to have a robot that would be as much as a companion for an older person. Feeding, washing cars, cleaning up, doing dirty work in the house and protecting a person from themselves when they are old and infirm. We've done studies with focus groups with the demographics in the United States.

It seems to me that it's more likely that I will find the Japanese, who have a larger percentage of old people than we do, saying that old people no longer want to go live with their children. They want to live independently. Their nursing homes are even more expensive that our nursing homes.

I remember Secretary Califano saying that if you could postpone a nursing home, for those entering a nursing home, for one month, it is worth $1 billion per year. The problem I have is that any time I ever mention putting robotics in the service of handicapped person or an old or infirm person, they cluck and say what a charitable thought. It's not charity. It's economically very attractive. Compare what one has with a robot in the home to what $50,000 or $60,000 per year is for a nursing home and a poor quality of life.

Ms. HORN. To follow up on that, is there any projection of per unit cost? What kind of technical maintenance is needed? I know that those of us who have flashing lights on our VCRs—

Mr. ENGLEBERGER. I'm certainly one of those with a VCR. It must be very user friendly. We have a product now which is a subset, a nurses aid subset, in a Danbury hospital. It is going into other hospitals now. It must be extremely user friendly. It talks in English. You use an ATM keyboard to direct it. It can go to any floor in the hospital. It has no wires on the floor. It calls elevators by itself. That's just the base of what this machine would be.

Going on, you're talking about a machine in production which would sell for about $50,000. The way I tell people about it is that it would be built into your home and you put it into your mortgage. This is one time you can get the Government, because it will be deductible as part of the mortgage. It will be a luxury product at the top. It will be very attractive for life care centers which are becoming popular.

We have an architectural firm who has designed three of their units, even though they know I don't have such a robot, with changes so that a robot could be installed at a future time. What you have to do is very modest to make a user friendly language, voice communication.

It will cost about $50,000 and service for this class of equipment will be about four percent to seven percent of the acquisition cost per year.

Ms. **Horn**. The unit in the Danbury hospital is just a model? It's not a production line?

Mr. **Engleberger**. We've built 10 of them so far and this machine is now run with the people in the hospital running it without our help. It works day and night. We are now going into Mt. Sinai in New York, into Downey Hospital in California, and into Raritan Bay in New Jersey.

It's a courier. We rent the machine for $5 per hour which is less than most wages. Our hospital is importing people under contract from the Philippines to do this kind of work. Here we have a machine that is $5 per hour. You just hire it and fire it, if you don't like it.

Ms. **Horn**. I think that has incredibly interesting applications and at $15 million, that doesn't sound like anything, even for a three year payback. I was thinking joint venture, but $15 million is small change to these people.

Mr. **Engleberger**. That is what I say.

Ms. **Horn**. I can understand your frustration.

Mr. **Engleberger**. Unfortunately, I am unable to get through. I think I'm reasonably eloquent but, I can't get through to these companies or the Government. There are a number of people that say it's a great idea.

If you go to NSF, DARPA, anybody, they say it looks like you could do that. If you can do it you can't get our money. You only get our money when you can't do something.

Ms. **Horn**. We have the R&D, we just collapse at the default line?

Mr. **Engleberger**. If you go to NIH, they're going to say who are the clinicians. They're not interested in any kind of development hardware that would help someone. I want to know which doctor of high reputation would do the clinical study. They are not interested in hearing from a lousy, old engineer.

Ms. **Horn**. I will defer back, Mr. Chairman, and we will see where we are on our schedule.

Mr. **Lewis**. Thank you.

I have one last question and I will be turning the chair over to Ms. Horn. This is for both of you.

Would you recommend a leasing scheme, similar to the Japan Robot Leasing Company, that would allow small U.S. companies to turn capital cost into operating cost through one year write-offs?

Mr. **Engleberger.** I'm not sure whether the one year write-off would be all that important. I'm reminded of a program that the National Bureau of Standards, now NIST, started, the Advanced Manufacturing Research Facility. It was a wonderful thought. We will put all of this automation, robots, NC machines into an area and every small businessman can come in and learn about them. He can train and will have the background to go out and use them.

The only people that ever came were big businesses. They never got the small people to come in. People from large companies came, the research people. I'm not sure that telling someone to get a one year write-off is as important as the other Japanese side of this coin.

Let them rent the machine. There's a big distinction between lease and rent. The rent does not commit the capital structure of the small company. If there is a rental program and someone puts the machines out on a rental basis, then they look at that piece of equipment as returning money all the time. If all you do is have a commitment of your capital resources on a lease basis, even if you write it off for a year, you are going to be afraid.

Dr. Kegg. I agree with the program that you propose. I also agree with Joe Engleberger's comments.

The key is that if you can reduce the cost of new technology in the margin you will certainly induce more people to partake of that technology. However, if you wish to make an order of magnitude change, you have to do something very powerful with money.

Mr. Lewis. Thank you, gentlemen.

Thank you, madam.

Ms. Horn [assuming Chair]. No further questions of the panel.

Thank you very much, gentlemen. It's been very interesting testimony.

Ms. Horn. On our next panel, we have Leo Reddy who is the President of the National Coalition for Advanced Manufacturing, Daniel Koenig, the Vice President of Manufacturing, Steinway and Sons, and William Morin, Director, Council on High Technology.

Welcome gentlemen and I believe you heard our chairman state that there are so many conflicts this morning, that people will be coming and going. Your statements are entered into the record in their totality as well as your comments. That way those of us who have to move in and out have the opportunity to catch up with what we have missed at a later time. Your statements will be entered in the record.

You may start, Mr. Reddy.

STATEMENT OF LEO REDDY, PRESIDENT, NATIONAL COALITION FOR ADVANCED MANUFACTURING, WASHINGTON, D.C.

Mr. **Reddy.** Thank you very much, Madam Chairman.

I would like to focus my comments this morning on public policy. Mainly, what is the appropriate and effective role of the Federal Government in effecting manufacturing competitiveness.

In making these comments, I'm pleased to note that I don't need to spend time defining the issue. I think Mr. Valentine, in his opening statement, did an excellent job. Many of the other panelists and members have also embellished on that point.

I would like to make the simple statement that the mundane, day to day, process of making products is the engine of economic growth in our country. When we talk about manufacturing, we're not talking about a marginal issue. We are talking about the very engine of growth, the life blood of our Nation. We're also talking about the primary generator of revenues which enable government to do the many things it needs to do in the national and public interest. For that reason, I congratulate you for dealing with this subject. It is a central question for our nation.

In making my comments on public policy, Madam Chairperson, I'd like to say first that I'm not making these comments of my own behalf, but on behalf of a new coalition created less than two years ago of many types of institutions around the country who are specifically focused on modernizing the Nation's industrial infrastructure. When we hear the word infrastructure, we think of a different set of issues, all of which are important, but there's also a question of our industrial infrastructure. In attacking this problem, we've pulled together a coalition of large, medium, and small companies, of national trade and vocational associations, of over 100 centers of manufacturing technology, research and education, training and extension.

In several meetings and conferences that we have held for more than a year we have asked the following question: In our effort to try and stimulate a national program to revitalize our industrial base and to try to improve the productivity and quality of our products, what is the proper role of the Federal Government in this process? I'm pleased to report that we have been able to pull together all the recommendations that have come in from various corners of the country into a white paper which we published last fall. Copies of that paper have been made available to the committee and to other guests here in the room.

Basically, in this paper we have focused on the industrial modernization process. In the area of human resources, for example, we focus on technical training, workforce skill training, not on K-12 or math/science/engineering education, although they are very important. In the area of loan policy, cost of capital, tax policy, and so forth, we have focused on incentives related to making it easier for firms to acquire new plants and equipment.

I'd like to focus this morning on our recommendation with respect to technology. There are basically two pillars in our proposals for Federal policy in the area of technology related to manufacturing. The first is the development of advanced manufacturing technologies. The second is the deployment of both new and off the shelf, existing and readily available, technologies into the industrial base. Allow me to introduce a few thoughts on both of those subjects.

First, in the area of developing new technologies, the competitiveness of industry today relies heavily on the ability of a company to produce products that have high quality, are reliable, are responsive to customer needs, and can be delivered on time. However, to achieve those standards, a company must have the ability to produce quality products, precisely made products, and rapidly produced products. This, in turn, depends upon a whole host of corporate factors. As Mr. Mettler pointed out, you are talking about the whole enchilada.

There are many factors that go into this. Technology alone is by no means the only factor. However, technology is a very critical factor in this process. A company, in order to survive in the global marketplace, must continually improve its process technologies from whatever point it is on the ladder of technological improvement. This is absolutely vital to our economic competitiveness. However, when you look at the Federal Government's budget for research and development, you will find that the funds allotted to advanced manufacturing research represents under 2 percent, about 1.5 percent, of the overall Federal budget. Our coalition would submit, with all respect, that we must fundamentally change these priorities if our manufacturing industries are going to be competitive. We must make a fundamental basic change.

For that reason, we are please to see some signs of recognition of that fact. We are pleased to see that the Critical Technologies List produced by OSTP does give manufacturing technologies a high place on that list. We were delighted with the report of the Council on Competitiveness. Our own white paper has a good deal of documentation on this subject. We're pleased that NCMS is getting underway, I think, successfully. We are pleased that the Department of Commerce's Advanced Technology Program is beginning. However, these are mere beginnings.

This is just the very advent of what needs to be a much more significant effort. What we propose specifically is that each department of government that has an R&D program on manufacturing technology reexamine their priorities to give higher priority to manufacturing technologies. We propose specifically that in the fiscal year 1992 budget, the total government spending level for manufacturing technologies be raised by $300 or $400 million. Out of a $76 billion R&D budget, which is what the Administration has proposed, this would be a small increase from 1.7 percent to a little over two percent. We would hope that during the 1990s, hopefully by the mid 1990s, that percentage could go up to roughly 10 percent of the Federal R&D budget.

We are very aware of the current constraints on Federal spending and sympathetic to the needs for fiscal prudence. We are not suggesting additional funding for this. We are suggesting that these funds be obtained through reprioritization. The Council on Competitiveness report recommended that this kind of funding be derived through stretching out what they call showcase projects. We would agree with that. We think that given the vital importance of competitiveness to our nation's future that it is only prudent and necessary to begin to stretch out projects like the space based portions of the SDI program, like the Man to Mars program, like the space station, like the Mission to Planet Earth programs, and so forth. These are all valuable projects. They are certainly in the national interest.

It is simply a question of balance. We must realize that industry and government need to cooperate more closely in order to bolster our manufacturing technologies and that is one way to do it. I've explained that in greater detail in our report and white paper in the area of technology development.

If my fellow panelists would permit me a few more minutes, I would like to turn to a subject which is more important that the one that I just mentioned, the deployment of existing technologies. If you look at the rates of adoption of advanced production technologies, we have a lot of data available on this, you will find that American industry is lagging behind both the EC and Japan. Within that spectrum, you will further find that the small manufacturers of the United States are way behind the large manufacturers. There are many reasons for this. They have to deal with cost of capital, training, management attitudes and many other things. However, this is a major factor creating the erosion of our industrial base, the hollowing out of our industrial base.

To underline the importance of this issue to the Nation, I'd like to refer you to my testimony where I have a pyramid chart which dramatizes this point as strongly as any example I've seen. It's on page six. This chart, shaped like a pyramid, is based on figures from the Bureau of the Census. It groups manufacturing firms by employment size. If you look at the top of the chart, you will see that the number of firms in our country that have over 500 employees number 5,500. This is out of a total manufacturing base of 362,000 firms. I think that many people in the country and most people in Washington don't grasp the fact that our manufacturing base is made up of firms with 500 employees or fewer. It is precisely in this infrastructure that we need to make more information and more technology available.

Our specific recommendation for doing that is that the same departments, referred to before, Departments of Defense, Energy, Commerce, and NASA, work on their tech transfers. All of them have an obligation to transfer some of that technology. They should devote a certain percentage or portion of that effort to support deployment centers around the country. By deployment centers, we're referring to the hundreds of community colleges, technical colleges, university extension programs, state economic development agencies, and so forth, that work very closely with those small manufacturers that I pointed out on the pyramid. Those institutions need more staff. They need more facilities. They need more help in their effort to provide training, education and factory assistance to that manufacturing base, the small and medium sized companies. Therefore, we feel very strongly that there be much greater attention and resources devoted to that issue by the Federal Government.

Let me close by saying, Madam Chairperson, that these ideas have been discussed on the Senate side. At the present time, in Senator Hollings' and Senator Bingaman's office, they have used the white paper as a blueprint. They are drafting the Omnibus Manufacturing Technology legislation right now embodying some of those concepts. I hope that the House side will take an interest in that legislation and be supportive.

Thank you.

[The prepared statement of Mr. Reddy follows:]

A National Strategy for Manufacturing Technologies

Testimony by Leo Reddy
President, National Coalition for Advanced Manufacturing

Before the Subcommittee on Technology and Competitiveness, House Committee on Science, Space, and Technology, May 9, 1991

Introduction

Mr. Chairman,

I appear before you this morning as a spokesman for the National Coalition for Advanced Manufacturing (NACFAM). NACFAM is a broad-based coalition committed to the modernization of the nation's entire industrial infrastructure through the accelerated development and adoption of advanced manufacturing technologies and related business-management and education-training programs.

Founded here in Washington less than two years ago, NACFAM has emerged as a focal point in the nation's capital for advocating public policies more supportive of industrial base modernization. Starting as a grass roots organization, NACFAM has grown rapidly. We can now speak for over 160 institutions from all the major sectors of the nation's manufacturing enterprise: small, medium, and large manufacturers; national trade and technical training and education associations; and centers of manufacturing technology research, training, and education. Our national association members represent over 70,000 firms and 47,000 vocational and education training centers.

Given that NACFAM's mission is closely tied to the subject of this hearing today, I especially welcome the opportunity to present our organization's views on the appropriate and effective role of the federal government in an overall national effort to bolster the productivity, quality, and competitiveness of American Industry through the use of manufacturing technologies.

In my presentation , I will address all the questions posed in your thoughtful and well-prepared charter for this hearing. Mr. Chairman, I am in a position today to articulate our answers to those questions in the form of a quite specific proposed strategy for federal action. . This strategy is spelled out in detail in a NACFAM White Paper, published last fall, entitled Industrial Modernization: An American Imperative.

The strength and legitimacy of this document lies in the fact that its recommendations derive from a series of conferences and meetings sponsored by NACFAM for over a year and has been reviewed by all the organizations in our national membership. It thus represents a broad cross-section of private sector views from all around the nation.

In the field of technology, our strategy is built around two pillars:

- First, the accelerated development of new manufacturing technologies
- Second, the accelerated deployment of both new and off-the-shelf manufacturing technologies.

Federal programs in both fields--development and deployment

--must be responsive to the practical needs of industry and leverage the excellent resources that already exist in the private sector. To make a significant difference in the nation's economic growth, strength and competitiveness, these programs must be substantial and adequately funded. Our manufacturers do not need more "pilot programs" and "models." They already know the nature of the problem and what works. What is needed is serious action, even if hard choices are required.

In our view, funding for programs to intensify both the development and deployment of manufacturing technologies should come, not from increases in overall federal R&D spending levels, but from reprioritizing and reallocating the R&D and tech transfer funds of the various federal agencies that have significant manufacturing technology programs, especially the Department of Defense, the Department of Energy, the Department of Commerce, and NASA.

With these introductory thoughts, Mr. Chairman, I would like to outline NACFAM's proposed public policy strategy for both the development and deployment of manufacturing technologies.

Technology Development

Manufacturing competitiveness today translates into a firm's capacity to design and deliver technologically superior products and services on time to the right markets at the right price. On the production side, therefore, highest priority goes to quality, delivery time, flexibility, and cost reduction.

Technology plays a vital role in a company's ability to meet these competitiveness demands. Continuous improvement of the means of production is essential to survival in the global marketplace.

Development of new process technologies, however, often exceeds the resources of even the largest firms, which explains the appearance of research consortia such as Sematech and the Microelectronics and Computer Consortia. Indeed, even Japan has proposed an international Intelligent Manufacturing Systems (IMS) consortium to share the costs of developing advanced manufacturing technologies and is beginning to increase its investment in its domestic R&D capacities in this field.

The most effective federal response to these challenges is to strengthen industry-government consortia in developing industrial technologies, including manufacturing process technologies. Fortunately, a modest start has been made in this field. In addition to Sematech, the National Center for Manufacturing Sciences (NCMS) is doing an excellent job of building government-industry cooperative projects. The Advanced Technology Program is underway at the National Institute of Standards and Technology (NIST). The private sector has begun to organize its own views more effectively on this subject. Examples are the recent report by the Council on Competitiveness, the efforts of the industry Ad Hoc Group working with the Department of Commerce to fashion an industry response to the Japanese IMS iniatitive, and the NACFAM White Paper.

Perhaps most importantly, the White House Office of Science and Technology Policy (OSTP) has articulated a U.S. technology policy that encourages industry-government collaboration on generic precompetitive research. Additionally, the recent list approved by the National Critical Technologies Panel, chaired by OSTP, has included several manufacturing technologies in its list of twenty-twonational critical technologies.

Yet the magnitude of all these undertakings thus far remains dwarfed by the low priority that the federal government continues to give to manufacturing technologies within the overall federal budget. For example, the Administration's FY 92 budget proposal, while recommending an overall 13% increase in federal R&D funding, to $76 billion, actually reduces slightly the funding for advanced manufacturing and materials: from $1.3l6 to $l.310 billion.

Is l.7% of federal funding sufficient for advanced manufacturing technologies sufficient, when those technologies are more immediately relate to this nation's economic security and industrial strength than any other in the government's R&D list? Our answer is unequivocally, no.. Given the nation's urgent need for increased productivity and growth, NACFAM fully subscribes to the proposal in the Council on Competitiveness report that showcase projects be stretched out in order to allow increased federal funding for precompetitive, cooperative research on industrial technologies. Our focus, of course, is an advanced manufacturing process technologies.

This does not mean, of course, that we do not see merit in such high-cost R&D projects as the Superconducting Super Collider, the Space Station, the Man-to-Mars Project, Mission from Planet Earth, and the space-based portions of the Strategic Defense Initiative research effort. These are all important projects for the nation. It is a question of balance. Our argument is that these programs should not be squeezing out funding for industrial technologies, which are much more relevant to the practical needs of U.S. industry as it faces the enormous costs of continuously updating its production technologies in order to remain competitive.

Our proposal, therefore, is for a national advanced manufacturing technology program, under the coordination of the Federal Coordinating Council for Science, Engineering, and Technology, that would require Defense, Commerce, Energy, and NASA to give higher priority within their existing budgets to promoting research and development of advanced manufacturing technology in the nation's universities, colleges, and centers of excellence and in industry-government consortia. We believe that a minimum of $300-400 million should be designated for this purpose in the FY 92 budget, funded largely through reallocations from showcase projects. We further propose that by the mid-1990's, funding for advanced manufactuirng R&D be increased from the current 1.7% level to 10% of the overall federal budget.

Deployment

Of equal or greater importance to the ability of our nation's manufacturers to move to world-class quality manufacturing is the deployment of existing, readily-avialable, off-the shelf technologies. As documented in our White Paper, the rates of adoption of advanced manufacturing technologies--such as programmable controllers, automated material handling, computer-numerically controlled machines, and computer-aided design--by U.S. manufacturers is remarkably low. It is well behind our leading competitors. Small to medium-sized manufacturers with fewer than

500 employees are far behind larger firms in adopting these technologies.

One result has been that the relative productivity and earnings of these smaller firms have declined steadily throughout the 1980's. This is a critical problem, because these firms constitute 98.5% of the nation's total manufacturing establishments (see enclosed pyramid chart), employ 63% of the manufacturing workforce, produce about half of the value added in manufacturing, and supply large firms with 40-70% of their parts and components. Indeed the largest firms are increasing their outsourcing for discrete manufactured parts.

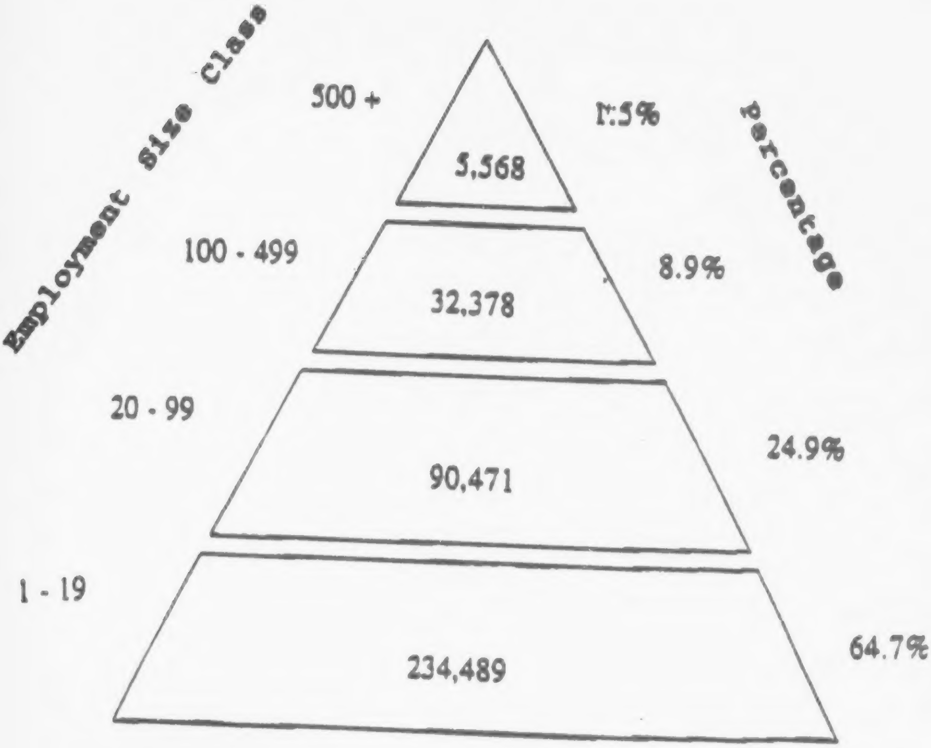
For these firms, the road to quality manufacturing based on state-of-the-art technologies is long and arduous. They often lack the capital, the tax incentives, the access to information, the management strategies, and the training to make this critical transition. They lack the infrastructure of support available to smaller firms in most of our industrial competitor countries needed to succeed--or survive--against foreign competitors even in the U.S. domestic market.

To address this problem, NACFAM proposes that the federal government leverage the assets already available around the country to deliver improved training, education, and in-factory assistance to U.S. industry, especially small and medium-sized manufacturers. There are hundreds of community colleges, technical centers, university-based extension programs, and other institutions that already deploy manufacturing technology to some degree to

NACFAM PYRAMID CHART

U.S. MANUFACTURING ESTABLISHMENTS

(SIC 20 - 39)
Total: 362,906



U.S. Bureau of the Census, 1988
Figures published December 1990

manufacturing firms in their geographic areas. Most have small, underfunded technical training programs.

NACFAM favors federal assistance to these centers to help them further develop their capabilities to work effectively with industry. In parallel with our proposed approach to developing new technologies, we believe that every federal agency involved with manufacturing R&D should also assume responsibilities in this critical field of deploying both new and off-the-shelf technologies.

The Department of Commerce already has a mandate to coordinate state industrial technology deployment programs, but requires much more meaningful resources to perform that task. The Small Business Development Centers of that Department's Small Business Administration should also be assisted in developing a greater brokerage/referral capacity in the field of manufacturing technologies. The Department of Defense has a vested interest in improving the quality of the tens of thousands of smaller firms that constitute the defense supplier and sub-supplier base. NASA has already developed a network of industrial applications centers that should be nurtured to ensure that some of the specialized production technologies developed under the auspices of that agency are made more available to industry. The National Labs under the Department of Energy have long experience in manufacturing and in working with specialty suppliers. Oak Ridge is setting an example by developing a manufacturing technology center available to firms in Tennessee and and other states.

To ensure the more active involvement of these agencies in the deployment process, NACFAM believes that Congress should require that the tech transfer programs of all these agencies include a substantial proportion of funding to bolster the capabilities of the hundreds of manufacturing technology deployment centers around the country. We further believe that the Department of Commerce should build upon its current programs to assume a leadership role in this field. We favor the expansion of Manufacturing Technology Centers, which can serve as a valuable resource for the many local deployment centers in their regions. We favor building upon the State Technology (Boehlert-Rockefeller) Program at NIST--which the Administration has once again proposed to eliminate.

Of course, deployment also requires a much better trainined workforce and the availability of capital to invest in new plant and equipment. Our White Paper addresses those issues as well.

Conclusion

Today, Mr. Chairman, I have focussed on the federal role in stimulating the development and deployment of manufacturing technologies. The recommendations I have made reflect the views of the constituencies nationwide that are committed to modernizing the nation's industrial base.

I am please to report that members of Senate committees concerned with technology have used the recommendations in the NACFAM White Paper as the blueprint for major new legislation in this field. Both Senator Bingaman and Senator Hollings will be introducing legislation soon that incorporate the recommendations I have made to this committee. I urge that this Committee support legislation of this kind this year and reflect its actions in its recommendations for the FY 92 federal budget.

Ms. HORN. Thank you, Mr. Reddy.

Mr. Koenig?

STATEMENT OF DANIEL T. KOENIG, VICE PRESIDENT OF MANUFACTURING, STEINWAY AND SONS, MEMBER, AMERICAN SOCIETY OF MECHANICAL ENGINEERS, LONG ISLAND CITY, NY.

Mr. KOENIG. Thank you, Madam Chairman and members of the subcommittee. Good morning.

I'm Dan Koenig, Vice President of Manufacturing for Steinway and Sons. I'm also a member of the Board of Governors of the American Society of Mechanical Engineers.

I'm here today to present the views of the ASME's Council of Engineering and their Industrial Advisory Board on action that we feel is needed to help move America to the forefront of world manufacturing. We believe that the development and deployment of critical manufacturing technologies should be given a high priority in any national technology initiative for many reasons.

One reason is that advance manufacturing will be the key to commercial deployment of other technologies on the National Critical Technologies list. A focus on manufacturing would serve the broad national interest rather than the special interests of a particular sector.

At the same time, the urgent nature of the technological competitiveness and the interdependence of many critical technologies on the panel's list makes it important that the first steps to address this problem encompass this National Critical Technologies category in its overall aspect. To the nations who succeed in critical technology development and deployment, we believe there are three overriding requirements.

First, we must begin to operate with a clear understanding that the rate of development and commercialization of advanced technologies is very rapid. Time is a competitive weapon and has been used very successfully by our competitors. Cycle time required to introduce new technologies has been excessive in the U.S. We must pick up the pace to compete. We have a wall between development and application that has to be removed.

Second, we must have national leadership to champion policies and programs in support of technology development. The White House, through the OSTP, the Critical Technologies Institute, and the Technology Administration could and should provide this leadership.

Third, we must have a detailed plan for critical technologies overall. It must state where we want to go and how we want to get there. It should be directed to emphasize more effective exploitation of technology that we develop here in America. Such a plan might be crafted through a summit of national public and private sector leaders along the lines of the Education Summit which was convened by the White House. Whatever the vehicle, it is essential that industry have a prominent role in setting the Nation's technology agenda.

In addition, there needs to be a fundamental reevaluation of the Government's role in support of technology development. The Federal Government has been, traditionally, a major source of support for basic science through the funding of university research. However, the closer science moves to applied technology, the more government shies away leaving technology development almost solely to the private sector. Mechanisms where the government can support technology development without dictating product lines to industry are very important.

We believe that the Federal Government should take the following steps to further manufacturing technology development.

One, increase funding for manufacturing under the advanced technology program at the National Institute of Standards and Technology and the engineering directorate of the National Science Foundation.

Two, establish centers for manufacturing research technology where scientists from industry, government, and universities can work together on technology development and application.

Three, develop government procurement regulations that favor suppliers who invest in advanced manufacturing systems.

Four, support industry initiated, industry lead manufacturing technology development consortia.

Five, establish an award for outstanding manufacturing innovation. This award should be similar to the Malcolm Baldrige Award. It would promote industry interest and public awareness.

In our written statement, we have presented a number of additional recommendations for steps that the government should take to make it more responsive to three pivotal issues involved in technology development by industry, a need for rapid diffusion from the laboratory to the factory, development capital, and assumption of financial risk.

In the interest of time, I am not going to go into these recommendations in my oral testimony. However, I'd like to briefly touch upon the basic needs they are aimed at addressing.

First, the need for a U.S. economic policy that fosters investment in development and application of new technology.

Second, the need for reform of regulatory and legal policies to provide incentives for technology development and application.

Third, the need for the Federal Government to assume a more aggressive posture in support of the Nation's civilian technology base.

Fourth, the need for the Federal Government to coordinate R&D programs on related technology.

Finally, the need for government, at all levels, to assign a higher priority to support human resource development and the Nation's education enterprise. We thoroughly support the President's initiative on education, especially math and science in K-12.

In closing, I would like to underscore ASME's belief that industry must lead the way in technological innovation, but the role of government is pivotal for industry's success. While this statement emphasizes government actions, we well understand that it will take all of us to address this change.

We commend the subcommittee for initiating this series of hearings on the next step for the national critical technologies. We earnestly hope that we will soon see the start of a stronger government/industry/education partnership aimed at returning the United States to preeminence in the world of manufacturing. It is imperative that we begin to develop plans and take specific actions on this task without delay.

Thank you.

[The prepared statement of Mr. Koenig follows:]

The American Society of Mechanical Engineers

Suite 218
1825 K Street, N.W.
Washington, DC 20006-1202
202-785-3756

Statement on Critical Manufacturing Technologies

by the
Council on Engineering and Industry Advisory Board
of
The American Society of Mechanical Engineers

before the
Technology and Competitiveness Subcommittee
of the
Science, Space, and Technology Committee
of the
U.S. House of Representatives

May 9, 1991

Mr. Chairman and Members of the Subcommittee:

My name is Daniel T. Koenig, Vice President of Manufacturing for Steinway & Sons, and a member of the Board of Governors of the American Society of Mechanical Engineers (ASME). I am pleased to be here today to present the views of ASME's Council on Engineering and Industry Advisory Board on actions needed to help move America to the forefront of world manufacturing.

ASME is a worldwide engineering society focused on technical, educational, and research issues, with 118,000 members, including 21,000 students. From our vantage point as engineers, we have long advocated national leadership in U.S. technology policy. Since 1988, we have been pleased to see some of our recommendations become reality, including creation of the Technology Administration, renaming NBS the National Institute of Standards and Technology, establishment of the Advanced Technology and Manufacturing Centers Programs, publication of a U.S. Technology Policy, and now the completion of a cooperative, consensus effort to identify the key technologies for America's future.

This series of hearings on what we need to do to exploit these critical technologies is also a milestone. We commend you for this initiative, and we will work to assist you in every way that we can.

We well understand that success in this endeavor depends upon all of us, and that it will take time. While this statement emphasizes government action, it is important to note that government, industry, and academia are all partners, each of whom must take action in their own way. Technical societies such as ASME also have a role to play, particularly in furthering communication among the partners and in the transfer of technology.

U.S. Technology Policy

At the heart of the issue of critical technologies is U.S. technology policy.

It is ASME's position that, while industry must lead the way in technological innovation, the role of government is pivotal to industry's success. Last spring, the Society issued a General Position Paper on U.S. Technology Policy that called on the federal government to develop a coherent technology policy aimed at creating an environment in which technological innovation and application can flourish. Subsequently, the Bush Administration issued its statement of U.S. Technology Policy. This was a step in the right direction, but it is time to take action. The ASME paper recommends that:

--U.S. economic policy should foster investment in the development and application of new technology.

--The federal government should establish national technological goals and assume a more aggressive posture in support of the nation's civilian technology base.

--The federal government's civilian technology functions should be coordinated to facilitate the development and implementation of a national technology policy.

--Government at all levels should assign a higher priority to supporting human resource development and the nation's educational enterprise.

--Regulatory and legal policies should be reformed to provide incentives for technology development and application.

ASME also recommended that the White House Office of Science and Technology Policy (OSTP), "launch an ongoing initiative to establish a consensus among industry, government, technical societies and universities for setting national technological goals and for identifying critical technologies that require government support..." Eight months later, it was our privilege to provide recommendations to the National Critical Technologies Panel on four major technical areas related to mechanical engineering: manufacturing, materials, energy, and environment.

Today, we are pleased to have the opportunity to offer our recommendations for proactive measures to make the nation preeminent in the critical manufacturing technologies presented in the Panel's report.

Critical Manufacturing Technologies

We would like to underscore the strategic importance of manufacturing to our nation's economic competitiveness. While some U.S. manufacturers are doing well and reclaiming market share, others are having a hard time competing in international markets against large, vertically-integrated firms which in some cases are subsidized by their governments. The situation is particularly difficult for small and medium-sized manufacturing operations, which are a mainstay of our economy. While exploitation of the critical technologies is only part of the solution, the actions that can bring them to commercial success can also serve to benefit U.S. manufacturing across the board.

To compete in the world market, American manufacturers must make their products with higher quality and reliability, and must manufacture them more efficiently. Quality and reliability are absolutely essential to earn and to keep customer loyalty. To achieve the highest quality, reliability, and efficiency requires an integrated approach that encompasses organization, design methodology, and production processes.

We concur with the four manufacturing technologies included in the Report of the National Critical Technologies Panel: flexible computer integrated manufacturing, intelligent processing equipment, micro- and nanofabrication, and systems management technologies. Along with other technologies on the Panel's list, these offer means by which we can minimize the time, energy, and materials required to build products. This will also increase the opportunity for more manufacturing operations to utilize "design for manufacturability" techniques, "just-in-time" inventory procedures, "zero-defects" manufacturing processes, optimized designs through selection of compatible manufacturing strategies, and "near net shape" production.

We believe that development and deployment of critical technologies related to manufacturing should be given a high priority in any national technology initiative. Not only are they interrelated (necessitating concurrent development), they will also draw on and/or will ultimately be used in commercial deployment of other critical technologies. A focus on manufacturing would serve the broad national interests, rather than the special interests of particular sectors.

Overriding Requirements

How can we bring the critical manufacturing technologies to economic fruition for the United States? The urgent nature of technological competitiveness and the interdependence of many critical technologies on the Panel's list make it imperative that the first steps encompass National Critical Technologies overall. For the nation to succeed in critical technology development and deployment, we believe that there are three overriding requirements.

1. We must begin to operate with a clear understanding that the rate of development and commercialization of advanced technologies is very rapid. Time is a competitive weapon that has been used to advantage by our competitors. Cycle time required to introduce new technologies has been excessive in the U.S. We must pick up the pace to compete.

2. We must have national leadership to champion policies and programs in support of technology development. The White House, through the Office of Science and Technology Policy/Critical Technologies Institute and the Technology Administration, should provide this leadership.

3. We must have a detailed plan for critical technologies overall that states where we want to go and how we can get there. The plan would save duplication of effort, avoid gaps, and accommodate the overlapping needs of the various technology areas. It should be directed to emphasize more effective exploitation of the technology we develop in America. Such a plan might be crafted through a summit of national public and private sector leaders along the lines of the education summit convened by the White House. Whatever the vehicle, it is essential that industry have a prominent role in setting the nation's technology agenda.

Technology Development

In addition, there needs to be a fundamental reevaluation of the government's role in support of technology development. The federal government has traditionally been a major source of support for basic science through funding of university research. The closer "science" moves to technology, the more government shies away, leaving technology development almost solely to the private sector.

Mechanisms whereby the government can support technology development, without dictating product lines to industry, are very important. We believe that the federal government should take the following steps to further manufacturing technology development:

- Increase funding for manufacturing under the Advanced Technology Program at the National Institute of Standards and Technology, and the Engineering Directorate of the National Science Foundation.
- Establish national centers for manufacturing research and technology where scientists from industry, government, and universities can work together on technology development and applications. This might be patterned after the Fraunhofer Institutes in Germany.
- Develop government procurement regulations that favor suppliers who invest in advanced manufacturing systems for long-term cost benefit.
- Support industry-initiated, industry-led technology development consortia.
- Establish an award for outstanding manufacturing innovation, along the lines of the Malcolm Baldrige Quality Award, to promote industry interest and public awareness.

Changing How We Do Business

A number of organizations have prepared specific recommendations for advancing development and deployment of some or all of the critical technologies. These recommendations share a common theme: each partner in the enterprise must make fundamental changes in the status quo. For industry, it would necessitate a longer view and greater investment in research and human resources. For the educational community, it would call for greater attention to interdisciplinary approaches that cover the entire manufacturing process, from design to production and marketing. For government, it would mean changes that make it more responsive to three pivotal issues involved in technology development by industry: a need for rapid diffusion from the laboratory to the factory, development capital, and assumption of financial risk.

Among the actions that government should take to give greater support the nation's technology enterprise are:

--Reduce the **cost of capital**, including balancing the federal budget and encouraging private savings.

--**Accelerate depreciation** of high technology machinery to correspond to their shorter product life cycles.

--Institute **regulatory and legal reforms**, including simplification and stabilization of regulatory requirements, enactment of uniform national product liability law, and modernization of antitrust laws for joint production ventures.

--**Coordinate federal R&D** programs on related technologies. With regard to manufacturing, it is particularly important to coordinate Department of Defense programs with the Department of Commerce, and for both agencies to collaborate with industry and academia.

--Manage government advanced technology R&D based on priorities, rather than annual budgets, through **multi-year authorizations and appropriations**.

--Speed up and improve **technology transfer** from the federal laboratories and universities to American industry.

--Expedite **availability of federal facilities** to industry for advanced technology development, and accommodate confidentiality of proprietary data for firms working with federal facilities.

--Recognize that **standards** are an important part of the manufacturing process, both nationally and internationally; in order to get products on the market without delay, it is essential that standards be developed concurrently with the technologies.

--Foster open-minded national policies toward **cooperative international RD&D**.

--Support **manufacturing education**, via grant programs for colleges and universities, and by establishing a manufacturing extension service to diffuse technology advances.

--Overall, **maintain continuity** in government programs that affect the development and deployment of technology. This will help foster confidence among companies and lessen the risks associated with investments in advanced technology.

As I stated earlier, industry should lead the way in technology development but the role of government is pivotal to industry's success. This statement has emphasized government actions because it is presented in a government forum. This should not be construed to mean that government alone can solve the problem.

In closing, I reiterate that we are pleased with the work to date of OSTP on critical manufacturing technologies. We earnestly hope that this will be the start of a stronger government-industry-education partnership to return the United States to preeminence in world manufacturing technology. It is imperative that we begin to develop plans and take specific action on this task without delay.

Thank you very much for the opportunity to contribute to this discussion. I would be pleased to answer any questions you may have.

This paper represents the opinions of the Council on Engineering and Industry Advisory Board of ASME, rather than a position of the Society.

Daniel T. Koenig, P.E.

Daniel T. Koenig joined Steinway & Sons as Vice President of Manufacturing in 1987. He is responsible for preserving the craftsman-like tradition and performance of the world's finest pianos, while at the same time introducing modern manufacturing and design concepts. Prior to 1987, Mr. Koenig was employed for twenty-one years with the General Electric Company in various engineering and manufacturing positions.

He is a member of the Board of Governors of the American Society of Mechanical Engineers, a senior member of the Institute of Industrial Engineers, and a senior member of the Society of Manufacturing Engineers. He is the author of the books, Manufacturing Engineering, Principals for Optimization, and Computer Integrated Manufacturing, Theory and Practice, as well as many engineering and technical publications. In addition, he has held the position of Adjunct Professor, Mechanical Engineering and Manufacturing Management at Illinois Institute of Technology, Rennsaelear Polytechnic Institute, and Schenectady County Community College.

Mr. Koenig received his MSME from Union College, Schenectady, NY, in 1970, and his BSME from the United States Coast Guard Academy in 1962. He is a registered Professional Engineer in New York State.

Ms. HORN. Thank you.
Mr. Morin.

STATEMENT OF WILLIAM G. MORIN, DIRECTOR, COUNCIL ON HIGH TECHNOLOGY, NATIONAL ASSOCIATION OF MANUFACTURERS, WASHINGTON, D.C.

Mr. MORIN. Thank you.

You have my written testimony. I'll just give you a few very brief remarks.

Madam Chairman and members of the subcommittee, I'm William Morin, and I'm Director of the Council of High Technology of the National Association of Manufacturers.

On behalf of NAM and its members, I congratulate you and the subcommittee for holding this important hearing on manufacturing and critical technologies. I want to thank you for giving us the opportunity to express our views this morning.

Generally, NAM agrees with most of the points made so well by the other panelists today. Rather than repeat their observations, I would like to offer to you and the subcommittee a different and disquieting perspective of the relationship between technology, manufacturing, and public policy.

The main point that I would like to make this morning is that we suffer from a fundamental public policy disconnection in Washington. We suffer from it on two levels.

First, we suffer from a disconnect between the various efforts undertaken in the name of technology policy. A host of initiatives and programs have sprung up over the years that respond to specific needs. There is precious little coordination or connection among any of them. This panel could perform a valuable service by making some of these connections.

Rather than spend more time of on all of these wonderful technology lists that seem to be cropping up so often, do a crosscut of all the various programs that touch the technology development spectrum in this country. This crosscut should begin with policies and programs affecting science and basic research. It should continue to those that impact on technology and actual product commercialization. The results of this scrutiny, which should also focus on potential synergies between these programs, should give policy makers a better sense of what's needed and give industry a better sense of what's available. This would be a good start towards rationalizing technology policy and moving advanced manufacturing technologies from paper onto the factory floor. It is only a first step towards fixing the first disconnect.

The second disconnect we have in Washington, involves policy issues beyond specific technology policy. That is, there appears to be little or no recognition of anti-trust, education, energy, environment, fiscal, investment, tax, trade, and numerous other policies that also affect technology and the ability of manufacturers to profit from technological innovation. Until this linkage is better understood and, most importantly, acted on, NAM believes that discrete actions on technology policy alone will accomplish little. It will serve only to obscure the larger systemic issues we need to deal with.

Again Madam Chairman, this committee could serve as a catalyst for making these necessary connections. When you leave this hearing this morning, please don't remove you technology and competitiveness hats. Remember critical technologies, manufacturing and competitiveness when you consider other issues in other panels.

To conclude, Madam Chairman, NAM believes that there is no magic bullet that will strike down our competitiveness related problems. No matter how beneficent we are towards machine tools, robotics, manufacturing, and other critical technologies, technology policy by itself is simply not enough.

Thank you. I'll be happy to answer any questions you have.

[The prepared statement of Mr. Morin follows:]

MANUFACTURING
CREATES
AMERICA'S
STRENGTH

TESTIMONY

OF

WILLIAM G. MORIN
Director, Council on High Technology
NATIONAL ASSOCIATION OF MANUFACTURERS

Before the

SUBCOMMITTEE ON TECHNOLOGY AND COMPETITIVENESS
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY

U.S. HOUSE OF REPRESENTATIVES

On

CRITICAL TECHNOLOGIES: MACHINE TOOLS,
ROBOTICS AND MANUFACTURING

May 9, 1991

National Association of Manufacturers
1331 Pennsylvania Avenue, NW, Suite 1500 — North Lobby
Washington, DC 20004-1703 (202) 637-3000

The National Association of Manufacturers is a voluntary business association of more than 12,500 member companies and subsidiaries, large and small, located in every state. Members range in size from the very large to the more than 9,000 smaller manufacturing firms, each with fewer than 500 employees. NAM member companies employ 85 percent of all workers in manufacturing and produce more than 80 percent of the nation's manufactured goods. NAM is affiliated with an additional 158,000 businesses through its Associations Council and the National Industrial Council.

TESTIMONY

OF

WILLIAM G. MORIN
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Before the

SUBCOMMITTEE ON TECHNOLOGY AND COMPETITIVENESS
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U.S. HOUSE OF REPRESENTATIVES

On

CRITICAL TECHNOLOGIES: MACHINE TOOLS, ROBOTICS AND MANUFACTURING

May 9, 1991

Mr. Chairman, members of the subcommittee, I am William G. Morin and I am director of National Association of Manufacturers' Council on High Technology. On behalf of NAM and its members, I congratulate you and the subcommittee for holding this hearing on critical technologies and advanced manufacturing, and want to thank you for giving NAM the opportunity to express our views this morning.

Rather than focus on technical issues related to manufacturing and critical technologies, Mr. Chairman, I would like to offer you and the subcommittee a somewhat different--and, I hope, disquieting--perspective of the relationship between technology policy and manufacturing.

Mr. Chairman, the first point I would like to make goes to the very heart of this hearing and others like it. That is, for too long too many people in Washington have been searching far and wide for *the* answer that will solve our technology and competitiveness problems. If only, it is believed, we could develop just one *more* technology list, commission one *more* study or assemble *the* definitive blue-ribbon panel; maybe *that* would yield the solution--the magic bullet. It is NAM's belief, Mr. Chairman, that there is no magic bullet.

Instead, we all need to pay attention to the less glamorous issues that affect the ability of American industry to compete in the world today. These issues are seldom associated with technology, but they have an impact on manufacturing and technological competitiveness every bit as real as do the glitzy, "high-tech" ones.

Technology Policy

NAM agrees that there *are* some specific technology policies that are directly related to the ability of our member firms to generate, develop and commercialize technology. Last year, in fact, NAM developed some specific technology policy recommendations for Congressional attention. A copy of these recommendations is included with my written statement. Intentionally modest in scope, we believe these recommendations could be implemented relatively easily, both in political as well as fiscal terms. I should like to cite just a few of these suggestions:

- Involve industry more in the selection and planning of research in the federal laboratory system by establishing industry research advisory councils.

- Emphasize process-related manufacturing research in developing federal laboratory research agendas aimed at assisting manufacturers.

- Strengthen technology "marketing" activities throughout the federal lab system to make firms, particularly small and medium-sized manufacturers, more aware of the resources available.

- Encourage more productive relationships among companies through antitrust reform and within industries through efforts such as the Aerospace Industries Association's "Key Technologies" program.

- Restore and strengthen the government's ability to analyze economic data necessary to provide a better understanding of the factors, particularly technology, that drive international competitiveness.

These suggestions, as well as suggestions from other trade associations, professional societies, research organizations and others, are not particularly new or revolutionary. They are not technology-policy magic bullets, but they do recommend changes that industry believes are beneficial to technology development, application and deployment. Federal policy makers should pay attention to these recommendations.

There are also other issues regarding technology policy that need attention. For example, this year NAM will attempt to make some sense out of the jury-rigged menu of federal programs dealing with science and technology matters. From this, we hope to be able to make some specific recommendations on how this melange of programs can be coordinated better and their services made more worthwhile to their intended recipients. To name only a few examples, we have Science and Technology Centers and Engineering Research Centers under the National Science Foundation; scattered through the Commerce Department are the National Technical Information Service, the Baldrige Award, the Clearinghouse on State and Local Initiatives and other programs; in the Department of Defense are DARPA and ManTech; and the Department of Energy has responsibility for some of the finest laboratory facilities in the country.

These and other efforts--most of them very good ones--have grown up over the years usually in response to specific needs. Rarely have they been created with an eye towards how they might synergistically fit into a larger mosaic. This narrow and chaotic view of technology policy is bad enough when confined just to technology policy proper. Unfortunately, it goes beyond this and afflicts the entire range of public policy issues faced by manufacturers.

Beyond Technology Policy...

While we are involved in specific technology issues and believe them useful, NAM also strongly believes that technology policies alone are not enough. If antitrust, education, energy, environment, fiscal, human resources, legal, regulatory, tax, trade and other policies in this country all work to the disadvantage of industry, then even the best technology policy in the world won't mean anything. There is, unfortunately, an unwillingness to recognize the linkage between technology and other policies.

To illustrate this point, I have also included in my prepared statement an NAM chart titled "The Congressional Agenda versus The Competitiveness Agenda." As you can see, Mr. Chairman, industry and government are far apart on nearly everything. To give you a sense of the frustration felt by American industry, I should like to quote some recent remarks made by current NAM Chairman John T. Hartley, who heads the successful technology-based Harris Corporation:

> American industry and American workers have a major problem...with the layer upon layer of legislation, taxation, rules and regulations that Congress continues to impose on American business in an attempt to shift to industry more and more of the cost and the responsibility for our societal problems. At a time when U.S. industry needs to focus all of its resources on building international competitiveness, we find ourselves having to spend a disproportionate amount of time and our organizational energies and resources fighting against ill-conceived legislative initiatives that add nothing positive to the innovation and the quality of our products, but simply add to their cost and reduce their competitiveness.

Some members may dismiss this as corporate whining, but these are very real problems to manufacturers--problems that no amount of technology policy by itself can offset. These are the problems that need to be addressed if America is to become more competitive. To further illustrate the point, I would like to cite just one example of how a government policy usually considered separate from the technology policy debate has had, in fact, an enormous and direct impact on the ability of American firms to remain technologically competitive. That policy is the U.S. export control system on commercial products.

By the mid-1980s, this system had expanded so much that 50 percent of U.S. manufactured products required some form of prior approval from the U.S. government to get out of the country. To say that this had enormous implications for U.S. electronics, machine tools, computers, aerospace and other high-technology industries is an understatement. Things have improved somewhat since the mid-1980s, but a substantial amount of trade is still caught up in this net. The result is that U.S. technology companies have been forced to yield market share around the world to foreign competitors. Once these markets--and the technological edge that often flows from these markets--are lost, they are not easily regained.

Export controls is but one example of a non-technology policy having a tremendous impact on technology. There are numerous other policies that inflict similar burdens on technology and U.S. manufacturing's ability to use technology effectively. The problem is, they are not recognized as such.

...And Back Again

Mr. Chairman, I don't want to leave you with the impression that NAM sees nothing but gloom and doom. There have been some positive actions undertaken by the federal, state and local governments, and we applaud these. For example, though sometimes erratic, Congress and the executive branch have generally been committed to strong support for research and development activities and incentives.

Beyond R&D, federal programs such as the Regional Centers for the Transfer of Manufacturing Technology, the Advanced Technology Program and the State Technology Extension Program are useful experiments that may yield successful long-term strategies and results. The bipartisan approach to and support of the high-performance computing and communications initiative is right on target. There is also widespread bipartisan support for extending the National Cooperative Research Act to include production joint ventures that we strongly endorse. At a different level, regional and state programs to encourage technology development and deployment, education and technical training are a welcome change from earlier smokestack-chasing policies.

These are worthwhile endeavors, but to believe that they are substitutes for comprehensive action on the full range of issues facing manufacturers--i.e., a *national strategy*--is, at best, wishful thinking. Frankly, Mr. Chairman, compared to the cumulative impact of public policies and macroeconomic factors challenging manufacturers, these are simply inadequate.

Still, in many ways and for a variety of reasons, I believe we are entering a window of opportunity regarding technology-related policies. Slowly and painfully, we appear to be pulling ourselves out of the muck of ideological posturing towards the healthier ground of a reasoned debate on what's needed and what works. In moving toward a national strategy, it's absolutely essential to keep a broader perspective. We need to make the connection between policies that heretofore have been disconnected.

In short, Mr. Chairman, manufacturing cannot thrive by technology policy tinkering alone.

Thank you.

NAM

Technology Policy Recommendations

Executive Summary

American manufacturers, both large and small, face markets that are both increasingly global and competitive. A key factor in successfully meeting this competition will be the effective development, deployment and use of technology resources. There has been considerable debate over how to best accomplish this, particularly in defining the proper role of government. To date, however, few concrete actions have been taken.

NAM believes an essential role of government is to facilitate and encourage technological innovation and strategic thinking, and to exercise its inherent powers to mitigate the international competitive market distortions faced by U.S. companies. We also believe that this type of role for government does not compromise our underlying commitment to free-market principles. As a contribution to improving our global competitiveness, the NAM offers the following suggested steps that we believe to be achievable in the current political and economic climate.

First and foremost, NAM believes that a sound fiscal and monetary environment is the single most critical factor both in strengthening U.S. competitiveness overall and in devising effective technology policies in particular. In making the technology policy recommendations contained herein, NAM offers suggestions that are intended to be complementary--*and in no way replace or become alternative*--to ongoing NAM policy thrusts in areas such as deficit reduction, the availability and cost of capital, R&D tax incentives, improvements in education, product liability reform, increased protection of intellectual property rights, international trade, modernization of U.S. antitrust regulations and others. Rather, NAM's recommendations consist of three technology-focused issue areas for action and attention: a more constructive industry-government relationship; more effective use of the federal laboratory system; and consideration of alternative means of support for technology development. These recommendations are:

Industry-Government Relations

- Restore and strengthen the Commerce Department's ability to gather and analyze economic data necessary to provide a better understanding of the factors, particularly the role of technology, that currently drive international competitiveness.
- Encourage efforts to restore trust in industry-government relations.
- Increase participation by industry leaders (both business and technical) in the interagency processes for coordination of technology information.
- Institute a competitiveness information campaign based on the message "Keep America Prosperous."

The Federal Laboratory System

- Involve industry more in the selection and planning of research agendas at federal laboratories by establishing industry research advisory councils.
- Create technology "focus centers" at federal laboratories in those technologies or disciplines that build on the unique strengths and talents of the individual labs and are useful to industry.
- Emphasize process-related manufacturing research in developing agendas for the federal laboratories to help U.S. industry.
- Encourage regional collaboration among the federal laboratories, universities and industry.
- Promote and expand person-to-person contacts and personnel exchanges between industry and government laboratories.
- Strengthen technology "marketing" activities throughout the federal laboratory system to help more businesses, particularly small- and medium-sized ones, become aware of available resources.

Meeting the Future

- Expand and invigorate the current defense R&D effort and infrastructure.
- Provide the Advanced Technology Program with a degree of support sufficient to make possible its success.
- Allow and encourage more productive intra- and inter-industry relationships.
- Keep open and explore options to support even further "downstream" pre-competitive development efforts in enabling technologies if such support is deemed necessary.

Technology Policy Recommendations

Introduction

In setting forth its policy recommendations, the National Association of Manufacturers proceeds from the conviction that manufacturing is the foundation upon which rests this nation's economic strength and national security. Many government policies, however, tend to inhibit the competitiveness of American manufacturers, with deleterious effects on the economy as a whole. While a consensus has been lacking as to what needs to be done to change this situation, NAM believes that there are steps that can be taken now to improve the ability of industry to flourish in the United States.

First and foremost, NAM believes that a sound fiscal and monetary environment is the single most critical factor both in strengthening U.S. competitiveness overall and in devising effective technology policies in particular. We assert that the federal budget deficit--and its attendant ills of high capital costs, shortened time horizons and others--constitute major burdens on the ability of U.S. manufacturers to compete. Failure to solve *this* problem could render all other actions ineffective.

For the most part, however, these recommendations avoid contentious budget and ideological matters. Rather, action on these issues is intended to be complementary--*and in no way replaces or becomes alternative*--to ongoing NAM policy thrusts in areas such as deficit reduction, the availability and cost of capital, R&D tax incentives, improvements in education, product liability reform, increased protection of intellectual property rights, international trade, modernization of U.S. antitrust law and others.

NAM's recommendations consist of three technology-focused issue areas for action and attention: a more constructive industry-government relationship; more effective use of the federal laboratory system; and consideration of alternative means of support for technology development.

These policy prescriptions are not propounded as all-inclusive or original. Rather, they are actions that can be accomplished in the current political and fiscal climate. NAM's proposals spring from technology-related matters we perceive to be important and offer options that we believe can make a difference.

Industry-Government Relations

Several domestic industry sectors have suffered competitiveness setbacks in recent years. Some part of this decline can be attributed to the practice of foreign governments targeting specific industries for development. Whether through trade policy, direct financial aid, technology development or providing leadership in establishing national goals to focus energy and resources on key segments of international industrial competition, these practices have frequently had a deleterious effect on domestic U.S. producers.

In the United States, it is not government's role to direct industrial development or, to use the shopworn phrase, "pick winners and losers." NAM believes it is an essential role of government to facilitate and encourage technological innovation and strategic thinking, and to exercise its inherent powers to mitigate the international competitive market distortions faced by U.S. companies. NAM believes that this type of role for government does not compromise our underlying commitment to free-market principles.

A Critical Need for Quality Data and Analysis

Essential information, such as timely technology assessments, and an increased ability to spot trends useful to overall strategic planning are critical if U.S. industry is to understand and successfully meet international competitive realities. To create this capability, government must work cooperatively with industry to define and determine the type of essential data needed, to facilitate its collection in a non-burdensome and non-duplicative fashion, to provide competent analysis, and be receptive to the results--whether favorable or unfavorable--such an effort would yield.

Out of this process, ideally, industry and government will be able to assess when losses in key industries are harmful to U.S. economic security and be prepared to lead public discussion to mobilize appropriate and effective policy responses.

The Catalytic Role of Government

Given our historical antitrust concerns and the disaggregation of U.S. industry among large and small businesses, such a dialogue would be difficult to realize if left entirely to industry's initiative. Nor can such a role be played only by state or local government bodies.

Only the federal government has the necessary convening powers to invite the various parties to the table and to provide the depth and breadth of information the challenges of greater cooperation and dialogue between government, industry, academia and labor require.

Such dialogue will foster a better understanding of the actions that must be taken to keep American manufacturing competitive. Combined with improved data collection and analysis, constructive government-industry cooperation will flow from the very process of this dialogue. When critical decisions or strategy judgements are needed, an open and trusting atmosphere will allow selection of appropriate and effective public/private advisory organizations that can bring forth better ideas and solid courses of action.

Government as Competitiveness Champion

The government must include in its unique communication role an effort to inform and persuade the public of the importance of a sound economy, and the factors--including that of a technologically driven, vibrant manufacturing sector--that go into one. Industry should stress the importance of quality manufacturing to a strong national economy as well as the need for manufacturers to seek international markets for their products. All other American goals, whether measured in terms of national security or standard of living, rest on our ability to perform economically. Economic well-being is not secondary to military well-being; rather, both are indispensable components of national security.

Recommendations

1. Restore and strengthen the Commerce Department's ability to gather and analyze economic data necessary to provide a better understanding of the factors, particularly the role of technology, that currently drive international competitiveness. One key area in urgent need of reform is the increasingly outdated system of Standard Industrial Classification (SIC) Codes. Also, recently legislated efforts to identify "critical" technologies (both commercial and military) and produce comparative assessments of technological developments and trends through the Departments of Defense and Commerce and the White House Office of Science and Technology Policy should be supported and encouraged. Closer industry-government cooperation is essential to make these efforts successful and worthwhile.

2. *Encourage efforts to restore trust in industry-government relations.* The federal government, whether through the Commerce Department, Office of Science and Technology Policy or other bodies, should continue and expand government's dialogue with industry and among industries to promote greater trust and confidence between the public and private sectors. One important outcome of this effort would be a sharing of strategic views relating to international business, economics, national security, and domestic well-being.

3. Increase participation by industry leaders (both business and technical) in the interagency processes for coordination of technology information. The revitalization of the Federal Coordinating Committee for Science, Engineering and Technology (FCCSET), the recent formation of the President's Council of Advisers on Science and Technology (PCAST) and the National Academy of Sciences/National Academy of Engineering's Manufacturing Forum, and the anticipated formation of an Industry Technology Advisory Board by the Commerce Department should be commended and supported in every possible manner by industry.

4. Institute a competitiveness information campaign. Starting with the president, a message to "Keep America Prosperous" should be articulated to the populace. The Department of Commerce needs an economic equivalent of "Smokey the Bear" to remind us of the importance of economic well-being, why global trade is vital to American industry and how manufacturing and technology supports the U.S. competitive position. For its part, the National Association of Manufacturers is actively exploring the feasibility of a multiyear manufacturing awareness campaign to return industry to the position of respect it once had among policy makers and the general public in this country.

The Federal Laboratory System and Technology Transfer

NAM regards the federal laboratory system in this country as a national asset. In light of far-reaching changes in the nature of national security and international competition, however, the mission and role of the entire federal laboratory system should be reexamined in terms of its usefulness. For example, should more of the labs' $20 billion R&D budget be directed to efforts more relevant to industry's needs? In short, what is needed now is specific input on how to improve the effectiveness of technology transfer.

Much attention has been paid to the idea of improving the flow of technology and innovation from the national laboratories to the commercial economy. In the past decade, in particular, legislation and executive orders have stripped away the legal and bureaucratic barriers to domestic technology transfer. Still, we are left with ingrained attitudes and mindsets that must be changed in order to gain the most benefit from our national laboratories.

Improved Lab-Industry Interaction

The federal laboratories' value lies mainly in two areas: human resources and equipment. Greater interaction with the former and increased access to and usage of the latter should be a goal of the manufacturing community. The relative lack of effective communication (or, sometimes, even an *interest* in communication) between federal laboratories and industry is a barrier to effective technology transfer activities. Both sides of this proposed dialogue need to communicate.

Industry must do a better job in searching out technology wherever it exists, whether in American or foreign factories and laboratories. Government must make a better effort at facilitating awareness and transfer of technologies to U.S. industry, particularly to small- and medium-size companies.

Manufacturing: Process vs. Product

Countries with the most sophisticated manufacturing processes will have an edge over those that invest their talents primarily in the products themselves. The United States has been hurt by the fact that it spends less than Japan or Europe on process R&D. According to MIT's Lester Thurow, "By 1993, if you're not the low-cost producer of a product and can't see yourself becoming the low-cost producer of a product, forget about inventing it. I can buy my neighbor's product and reverse engineer it, but I can't buy his process--the way to make it for less."

Finding and using "the way to make it for less" is achievable only if U.S. industry and government communicate and cooperate more.

Industry must implement innovative, low-cost manufacturing processes and systems that integrate, improve and shorten the production cycle (concurrent engineering). Just as importantly, the federal government should recognize the criticality of manufacturing processes in prioritizing and formulating its R&D budgets.

Recommendations

1. Involve industry directly in the selection and planning of research agendas at federal laboratories by establishing industry research advisory councils. Such advisory panels will ensure closer interaction and collaboration between industry and the laboratories from the earliest stages.

2. Create technology "focus centers" at federal laboratories in those technologies or disciplines that build on the unique strengths and talents of the individual labs and are useful to industry. Focus centers would complement efforts such as the National Science Foundation's Engineering Research Centers and Science and Technology Centers, numerous state-level "centers of excellence" and other programs already underway. The funding of any new industrial research efforts should be coordinated closely with the above existing research activities, as well as with the Small Business Innovate Research (SBIR) program, the Defense Department's Industrial Modernization Incentives Program (IMIP) and Manufacturing Technology (ManTech) programs, the Commerce Department's Advanced Technology Program and others.

3. Emphasize manufacturing and process-related research in developing agendas for the federal laboratories to help U.S. industry. Government policy makers should become more aware of the critical importance of manufacturing process and the need to nourish vigorous R&D in this area in allocating limited federal resources. In close coordination with industry, a larger role for the national laboratories in exploring solutions to these generic manufacturing problems should be encouraged.

4. Encourage regional federal laboratory/state agency/university/industry collaboration. These symbiotic relationships would foster increased attention to engineering and technical fields by students, provide universities with additional incentives they can use to attract students, and help industry by nurturing production of the next generation of talent for industry to draw upon. For traditionally less "glamorous" fields such as manufacturing, attracting greater student interest would be most beneficial.

5. Encourage and expand person-to-person contacts and personnel exchanges. Direct exchanges of this type are the surest means to accomplish technology transfer. Programs that bring industry researchers into the federal laboratory structure should be continued and efforts to facilitate greater participation by small and medium-sized businesses pursued. One means of accomplishing this would be to amend the R&D tax credit to allow a company's expenses involved in these exchange programs to qualify for the credit. A complementary program of encouraging government researchers to work temporarily in industry labs should also be implemented. This would not only provide individual manufacturers with a valuable resource but also introduce into the federal lab system a greater understanding and awareness of industry's needs (upon the federal researcher's return to the laboratory).

6. Strengthen the technology "marketing" role throughout the federal laboratory system to help more businesses, particularly small- and medium- sized ones, become aware of available resources. Assigning federal technology transfer entities a specific outreach, or marketing, function would require significant, but not impossible, changes in organizational structure (to rationalize the diffusion process), personnel management practices (to provide adequate incentives and rewards for success) and budgeting (to make effective marketing a realistic goal). A strengthened and expanded Federal Laboratory Consortium should be part of this effort.

Meeting the Future

The global strategic posture of the United States is shifting away from one viewed in principally military terms. The recent "end" of the Cold War has brought this shift into sharp focus, with economic power clearly moving to center stage. One key determinant of economic power will be the development and application of technology. The foundation of technological strength, in turn, lies in a vigorous R&D effort by both industry and government.

While there is disagreement in terms of scope and scale, few argue against a continuation of government's long-standing involvement in defense-related technology development. NAM believes that, whether or not the current diminution of strategic military threats is a long-term trend, the need to maintain technological capabilities to respond to potential threats remains. In fact, given that the U.S. military structure is likely to decrease quantitatively, the need for technological superiority becomes even more vital.

In the commercial arena, the private sector must retain its leading, though not necessarily exclusive, role in technology development. The ability to do this, however, requires a supportive government--one that at a minimum nurtures an environment conducive to innovation. Industry should carefully examine and evaluate its framework of arrangements within and among individual U.S. industry sectors as a means to achieve more productive and competitive relationships.

Adapting to Change

Competition among nations has always taken many forms, and only those socio-political-economic systems capable of adapting to the changing competitive environment can expect to continue. To meet the unprecedented challenges posed by the Second World War, for example, government-industry relations in the United States experienced significant changes. From a pre-war near-indifference of the federal government to science and research, it became accepted that there was indeed a legitimate and positive federal role in stimulating scientific education and advancement. The result has been nearly a half-century of strong government support for science research and experimentation, and a concomitant position of global scientific leadership.

Because of the increased emphasis on global "techno-economic" competition, the perceived "traditional" theoretical framework of industry-government relationships in the United States may now again be in need of adjustment. This does not mean that existing paradigms should be discarded in favor of government-led industrial policies or "technology-of-the-week" approaches. Rather, in light of anticipated international economic and competitive realities, alternate, industry-led means of promoting U.S. technological leadership in both defense and nondefense areas should be considered.

The Advanced Technology Program (ATP) created by the 1988 Omnibus Trade and Competitiveness Act, whose purpose is to assist U.S. businesses to carry out R&D on pre-competitive, enabling technologies, is one such vehicle.

Recommendations

1. Expand and invigorate the current defense R&D effort and infrastructure. The ability to respond rapidly to future defense challenges is a vital ingredient in maintaining U.S. national security. NAM believes that bolstering the existing defense research base is not at cross purposes with changes in the focus of the defense R&D effort, as suggested by the recommendations above.

2. Allow and encourage more productive intra- and inter-industry relationships. One prototype for this can be found in the Aerospace Industries Association of America's (AIA) Aerospace Technology Policy Forum and its "Key Technologies for the 1990s" program. These industry-led activities bring together government, academia and industry to define and support nationwide technology development efforts aimed at keeping this particular industry globally competitive. As a broad-based manufacturing association, NAM should take the lead in encouraging its members in all industry sectors to undertake similar, critical self-examinations.

3. Provide the Advanced Technology Program with a level of support sufficient to make possible its success. The ATP is a useful and important experiment that requires a clear sense of mission and purpose, a specified duration, adequate funding, an objective measurement of successfulness and a willingness to recognize the experiment's outcome in its totality--whatever the results may be--by industry and government alike.

4. Keep open and explore options to support even further "downstream" pre-competitive development efforts in enabling technologies if, through the analysis and processes proposed above, such support is deemed necessary. Clearly, programs of this type will achieve success only if: (1) the convening activity re-establishes trust, openness and confidence between government and industry; (2) the information and analytical resources are present to establish needs and opportunities; and (3) public opinion, government and industry all believe it is important and correct to do so.

– NAM, 1990 –

These recommendations were developed by NAM's Technology Policy Task Force, under the auspices of the NAM Council on High Technology. Questions or comments regarding these recommendations should be directed to Council staff director William G. Morin at (202) 637-3147.

NAM

THE 102ND CONGRESS

THE CONGRESSIONAL AGENDA versus THE COMPETITIVENESS AGENDA

HUMAN RESOURCES

Striker Replacement Civil Rights OSHA Reform Mandated Leave	Workforce Readiness Health Care Reform

ENERGY AND ENVIRONMENT

RCRA Reauthorization	Energy Production Incentives (OCS & ANWR)

INTERNATIONAL ECONOMICS

Export Controls	Export Expansion Market Access

TAX AND FISCAL POLICY

New Tax Revenues	Capital Formation Budget Enforcement Incentives

LEGAL SYSTEM

Environmental Crimes OSHA Crimes Sentencing Guidelines	Tort Reform (Product Liability and Medical Malpractice Reform)

Ms. HORN. Thank you.

Mr. Ritter has had to leave. We have some other members who have joined us.

Let me start by saying that was quite a challenge you issued to us, Mr. Morin. I assume that it is specified more in your written statement. I will look forward to catching up on that. We've heard repeated over and over, the difficulties we have getting things from the laboratory into the plant. I had some folks with me in St. Louis, my district is suburban St. Louis, recently tell me about a proposal that I did not know about because I came on board in January. It was in response to a NIST RFP that we did in the state of Missouri that would have gotten ahead about 600 small manufacturing companies who were looking for someone to come in and deal with computer inventories. They had a relatively modest list of technologies that they were going to take into these factories. It was an extremely user friendly proposal. Our state of Missouri does not have any matching funds. They had gotten these businesses to agree to put the dollars in which was going to add $6,000 per company to make up for the lack in matching funds on the part of our state. That was not approved by NIST. They are now scaling it down and trying to go out and find what I found a relatively modest sum of $800,000 to deal with 600 small manufacturing companies throughout the state of Missouri. I give that as an example of what I suppose I'll pose as a question. I find that absolutely appalling. Not that they didn't get the money from NIST because I know they have very limited dollars, but for lack of such a small amount of money, these sorts of good practices are not going to be able to happen in our state. It is because we are lacking in foresight in the area of matching funds and they are floundering for somewhere to go for a relatively small amount of money. Could you comment on that? Is that generalized throughout the country?

Mr. REDDY. I'd like to answer that point, if I could, Madam Chairperson.

I'm very familiar with the example that you've given. I'm also appalled. We have a case where some of your leading and very progressive academic institutions and institutes manage to get support from hundreds of firms who are willing to put up their own money for the kinds of assistance programs, technology transfer programs to small business that you are talking about. However, the regulations controlling the manufacturing technology program of NIST for some reason requires state matching funds. The same is also true with the Boehlert/Rockefeller program, the state technology extension program. That program also requires that only state funds be the matching funds. I would like to urge your committee that a very specific concrete step you could take to revisit those regulations in that legislation to introduce amendments which would make it possible to make both the manufacturing technologist and his program and the Boehlert/Rockefeller program available to proposers as long as the proposing institution is qualified and produce matching funds from any legitimate source. Those funds could come from state government, private enterprise, county government, or any combination of those different things. The Federal Government, itself, should be neutral on where those funds come from as long as they're from reputable sources. That small amendment to legislation would make a lot more sense out of this whole program and help Missouri as well. Thank you

Ms. HORN. I assume that there are other states in the same situation. Do you have any idea what the split is of states which have and don't have matching funds for this type of program?

Mr. REDDY. I don't have figures, but generally speaking, states are diminishing their funds for economic development, certainly in the state of Michigan.

Mr. KOENIG. May I say something?

Ms. HORN. Sure, Mr. Koenig.

I apologize for mispronouncing your name earlier.

Mr. KOENIG. It's been pronounced many other ways too.

ASME is in the business of technology transfer. Lots of times government programs, such as the NIST program, go unpublicized and the people they are aimed at don't even know they exist. One of the things we could do is find a better mechanism of getting the word out to small companies that help is available if they want some help. Secondly a lot of small companies don't even realize that they need help. Unless they are failing, they may just drift along making a living and that's it. There has to be some way of getting the word to the smaller companies that there is a tremendous amount of free technology available if you will make yourself available to go get it. One of the frustrations we have as a technical society is that we put on lots of programs that for the cost of coming to the meeting, you can meet and converse with the experts and perhaps see some demonstrations. It doesn't seem to take a high priority on the part of the small businessman. We have to change this attitude and I think that the Federal Government can do that by becoming part of the bully pulpit. An awareness function is probably more important that throwing money at a lot of these things. If a small company sees that there is a technology that can be helpful to them, they will find the money. They will invest their time and money into the project if they think they can make a profit. I don't care how much money the government whether local, State, or Federal is willing to put in. If a company thinks it's to complex or it doesn't meet the mark, they're not interested. Most businessmen are pragmatists. We have to recognize that and deal with it.

Mr. MORIN. Could I add something too?

Ms. HORN. Sure.

Mr. MORIN. I share your frustration with the situation out in Missouri. I would like to take that several steps back. I think one of the reasons for that is there's a fundamental misconception about the role of manufacturing in this country and the contributions it makes to our economy. Manufacturing accounts for something a little bit less than a quarter of this countries GNP. That's actually higher than it was 20 years ago. That is not in terms of employment but in terms of its contribution to the GNP. Policy makers need to be aware that from manufacturing comes everything. We have no services industry if you don't have manufacturers to supply the products as well as to buy the services. There has to be a greater awareness that manufacturing is the key to the economy. You have no defense if you don't have manufacturing.

Public policies have to be designed with that in mind or else we're sunk.

Ms. Horn. I was intrigued by a couple of comments on the plethora of agencies. As a relative newcomer, I'm still trying to sort them out. Not a day goes by that I don't get a new alphabet soup that I have to ask my staff to tell me what this is. Some of you mentioned a role that this committee might take or that ought to be taken, some leadership, somewhere, to get more coordination. I get the sense that we don't need more agencies or more organizations as much as additional focus and funding for the ones we have and better coordination of who's doing what. Perhaps you might comment on that, both in the public sector, Mr. Morin, and in the private sector, Mr. Reddy. You talked about a coalition that has been recently formed. Could you comment on that a little more, Mr. Morin, in the public sector?

Mr. Morin. Certainly, we have the National Science Foundation, for example. It runs Engineering Research Centers and Science and Technology Centers, good programs. The Commerce Department runs the Advanced Technology Program. They have a clearinghouse on state and local initiatives. They administer the Baldrige award program. National Technical Information Service has a wealth of knowledge waiting to be tapped. The Department of Energy runs their Energy Department laboratories which are a wonderful source of talent and equipment that are simply not used enough. The Defense Department has programs, DARPA, Mantech, things like that. All of these programs have grown up over the years in something of a Rube Goldberg fashion. They've been set up generally to address a particular function or problem. There has been very little thought given to how they tie into everything else that is going on. I think if we could examine these things to see how all of these pieces fit into a larger whole, I think we could get a lot more return on our investment in all these programs.

Ms. Horn. Do they talk to each other?

Mr. Morin. I don't know to tell you the truth. I don't think they do. They certainly don't talk to each other—

Ms. Horn. In any organized or coordinated way with a specific agenda about how to get from here to there.

Mr. Morin. I will say quite frankly, industry does not talk enough with all these programs. The Federal laboratories are a perfect case in point. Often times we hear people in industry saying that the labs don't have anything to offer us. I don't see how that squares if you look at who is visiting the national laboratories. A lot of representatives of Japan are visiting the national laboratories. Somebody has something out there.

Ms. Horn. Yes, Mr. Reddy?

Mr. Reddy. Thank you. I would like to comment on that.

Mr. Morin has described the situation accurately. I'd like to make a suggestion to what might be done about it. I think that anyone with experience in the Executive Branch realizes that it is a highly vulcanized place. The only way you can overcome that vulcanization is through Presidential leadership. The only way that the various departments and agencies will resolve their differences and coordinate to work effectively together in a larger public interest is if they have channels to report their differences directly to the White House. Our proposal on this is that the Federal Coordinating Committee on Science and Technology, that is the FCCSET Committee, which is under the chairmanship of the President's Science and Technology Advisor, there is the tie- in to the White House, assume a stronger interagency coordinating function in the area of technology and manufacturing technology. That notion is incorporated in the bills that I've just referred to. That is the only way to address the problem. If I could, may I make another observation. I would like to second the points that both panelist made about the bully pulpit and the importance of leadership. I won't dwell on this because we have some proposals spelled out in this area. One step in the area of leadership that we think would be very useful would be to have some legislation creating a manufacturing week. There have been some initiatives in the private sector but in terms of awareness of the vital importance of manufacturing to our economy, which Mr. Morin referred to and NAM has addressed in a very eloquent way, I would see a manufacturing week as a mechanism where you could in one place time the Baldrige Awards, there are also state quality awards. We could recognize and award vocational students. For example, the Vocational Industrial Clubs of America have national competitions to participate in something called the international skills olympics. It is a fascinating thing which is hardly understood. We should have senior officials from Washington showing up at those olympics to help our young people who are trying to improve their technical skills. A manufacturing week could put together in one place, a concentration on these recognition and award processes. I think it would help a lot. Thank you.

Ms. HORN. Thank you.

Mr. Ritter has rejoined us. I believe he had a statement.

Mr. Ritter?

Mr. RITTER. Thank you, Madam Chairperson. I have a statement which I would like to include in the record. I want to thank the chairman and the subcommittee for holding this very valuable hearing. We've been witnessing a plethora of extremely important reports that continue to call attention to the absolute essential position of manufacturing in America's economy, our standard of living, the decent quality of our jobs, our global economic power, and our position as a competitive nation. I think the country is coming back to the basics. I want to commend our witnesses here today. I have one of these mornings which only a Congressman can have. There are four different mark-ups and hearings going on at the precise same time. All of them have a bearing on me. In two on the situations, I'm ranking member. I feel what is going on here with this testimony is extremely important. I want to thank Leo Reddy. I had a chance to hear his testimony. I think this white paper, Industrial Modernization: An American Imperative, should be required reading for every policy maker, member of Congress, and member of the Administration. It puts together a kind of reality that I think is crucial for the future of this country. If we don't recognize it and act on it, it will be to our disadvantage. We cannot survive by just doing better R&D than the competition. That is where we are today. I understand from Mr. Morin's testimony that the bottom line to all of this R&D and science is actually making something. It is making it better. The miracle of Japan is not that they cheated, although they did do it their own way which is different that ours. Frankly, if the whole world trading system behaved as Japan, we wouldn't have a world trading system. We would all be poor. With all due respect to the gentlemen in the previous panel, and as Dr. Mettler said, our job is to get our own house in order and to get it in order real quick. The changing of the internal dynamics of Japan from afar while they are supplying us with $40 billion a year in T-Bill purchases, VCRs, Toyotas, Nissans, and transplant plants is limited. This is what America has to do. I want to thank the gentlemen for focusing on this idea of the deployment in this pyramid. This pyramid is also where it's at. When we're here, we're talking about critical technologies. One of the 22 is advanced manufacturing. As this pyramid points out, we have, from one to 99 employee manufacturers, 324,000 companies who don't have the latest and the best technology. Sometimes they don't even have an engineer working there while in Japan all of the small firms have engineers working there. It is a very generic problem that results from 30, 40, or 50 years of neglect. I want to associate myself with the remarks of the witnesses. It is imperative that we redirect at least what we can do from our point of view, this Federal R&D economy and begin underpinning that which is important in American industry, our jobs, our standard of living, and our prosperity. I'm sorry to take that kind of time for an opening statement, but I'd like to ask our witnesses, How is the political dimension of NACFAM evolving? You have a large organization. It is down at the grass roots to some broad extent through the country. If you want to influence policy, you have to influence grass roots politics. How are you doing? What kind of progress are you making there? Are you focused mostly technically and legislatively?

Mr. REDDY. Thank you for the chance to comment.

Thank you, Mr. Ritter, for your helpful comments about our white paper and our pyramid. We do think we are on the right track. I would say in terms of the effectiveness of this coalition effort which is essentially a grass roots political effort, we are trying to essentially develop enough voices behind this concern of industrial modernization to affect policy, corporate policy, state policy, and particularly Federal policy, given the leadership role of the Federal Government. The way we have done this so far is primarily through legislation. We have tried to focus on specific pieces of legislation. We worked last year on the Defense Authorization Act to add a new $50 million program called the Defense Manufacturing Technology Enhancement Program in the Pentagon. We wrote into that legislation the hope that the Pentagon would make greater use of deployment centers which they are currently resisting strongly. We're thinking of various end runs around that one. We worked on the Perkins Act for vocational training to try to put in the TechPrep program, essentially a whole new approach to developing technical workers and skilled technicians through combining the last two years of high school with the first two years of community college, a seamless web of training. I could give you other examples, but we are working on specific bills. We don't yet have the strength or the numbers to begin to go with a public campaign of advertising, but we hope to reach that point. Basically, our focus is on working with both the Administration and the Congress on specific programs in the hope that the cumulative effect of changes on discreet manageable items will add up to a major impact which is why I came back and focused on the specific question about how we can overcome the problems we had with the Missouri program.

Mr. RITTER. Are you working on any specific campaign to get to the bottom of this pyramid where you have 325,000 companies that are entrepreneurial companies and companies that are expanding in employment rather that reducing employment to cut costs? Have you focused on any particular tax mechanism, for example, some type of investment tax credit in productive equipment and facilities to get away from some of the abuses that we had like small businesses buying a Mercedes because they couldn't afford not to. Depreciate it and then sell it after five years. Are you doing something that gets down to that grass roots with the knowledge that when you have a major Federal program, I'm the father of ATP, I think it's important that we do it, but let's face it, the competitors for the advanced technology program are not going to be most of your companies, the 325,000 of them. Is there some way we can break this barrier on getting off the shelf technology, knowledge, and capability into these smaller companies. Deployment centers is one thing I think they're doing a great job in some places and not so great in others, it's like anything else. If you could get some kind of internal stimulus to these small firms, wouldn't that be a boom to manufacturing?

Mr. REDDY. If I could answer that in two parts. First, on the deployment center side, Mr. Ritter, while I subscribe Mr. Koenig's comment that managers of small firms will pick and choose their own technologies, we do find that in the smaller firm area that there is a problem of access to information. We do think that this center network of hundreds of community colleges, technical colleges—

Mr. RITTER. I think the network has to be a critical functioning mass before it's really effective as opposed to spot checking here and there.

Mr. REDDY. Absolutely, we see that in this context that the manufacturing technology centers can provide a valuable resource to those smaller centers.

Mr. RITTER. The states too. Are you focused and working with the state programs like Pennsylvania's industrial resource centers?

Mr. REDDY. Absolutely, we consider all the Pennsylvania centers the whole greater Minnesota corporation network, the Ohio Edison programs, all of those programs to be part of the network of centers as we would define them.

Mr. RITTER. What about the tax mechanisms?

Mr. REDDY. On the tax measures, if I could turn to that.

Mr. RITTER. Focus on one thing that we know will flow capital into manufacturing as opposed to the next best hotel/casino in Las Vegas.

Mr. REDDY. Let me say on the deployment side, we have those concepts of strength in deployments centers built into some legislation that we are working on with Senator Bingaman and Senator Hollings right now. There is legislative action on that frame. However, on the tax side, we have a set of targeted modernization incentives that go directly to this issue. How can we help the small and medium size firms get the kind of patient longer term capital to make the investments that they need to make in plant and equipment.

Mr. RITTER. I'm not one of these people that believes that manufacturing constitutes the crown jewels of any modern industrial economy. Like Japan, if you look at the small business loan setup and the capital transfer setup, it is the small and medium size business that really get the benefit of the government working through the banks to see to it that you can get 1 percent capital, you can get .5 percent capital that you don't have to pay back until your 10 year time is up if you're making something, putting things together, perfecting products and processes. One thing they have is that they know that wealth emanates from making things, actually putting it together or putting it together better. I am disturbed when a key member of our Administration collaborates potato chips with computer chips. It's something only an economist would say.

Mr. REDDY. If I could comment, Mr. Ritter. The specific proposals for tax, loan, and cost of capital issues are outlined in our white paper. I won't go through those in detail since you've drawn attention to that paper. I will give you one example. We are proposing a 10 percent investment tax credit for new and refurbished plant and equipment both hardware and software. We have based this on the Japanese tax code. Since you mentioned Japan, they have a very similar kind of tax credit, we have read it in the Japanese tax code, except they give a 20 percent tax credit. They give an additional 20 percent tax credit to what they call SMEs, small and medium size enterprises. We're proposing something more modest, basically a 10 percent tax credit confined only to product enhancing plant and equipment in industry. It's not a general investment tax credit. It is tied only to productivity enhancing investment. We have proposed an additional five percent to small and medium size companies. In our view that is very sensible. We are also trying to work into that, the concept that the credit should be provided for related training. Training is fundamental to this. That's one of the keystones of our proposals in this area.

Mr. RITTER. Again, I want to commend you for a basic, down home, understandable set of principals that transform the debate from one of us owning the cutting edge but not being able to build the rest of the blade, knife and handle that goes with the cutting edge. If the cutting edge is microscopically small, it may be also relatively cheap for competitor nations to buy it. Then they can build the rest of the blade, the handle, and the whole knife. Thank you and I'd like to let you know that at the NCMS, the National Center for Manufacturing Sciences, meeting in Dallas, I had the honor of speaking last week. I announced that we're putting together a resolution for a national manufacturing week here in the House to focus attention on the essential and critical nature of "Made in America" to American prosperity. Thank you, Mr Chairman, for your indulgence.

Mr. VALENTINE [RESUMING CHAIR]. Thank you, sir.

The Chair recognizes at this time the distinguished gentleman from Arkansas, Mr. Thornton.

Mr. THORNTON. Thank you, Mr. Chairman. Again, I want to thank you for scheduling these important hearings.

Pursuing the line of questioning of "Made in America," caused me to think of the experience that T. Boone Pickens has had in trying to penetrate the management of a Japanese enterprise and it gives me some concern that the wall exists with regard to American investment and participation. At the same time, I see many instances in which American companies are wide open to ownership by people around the world. That may be okay, but should there be any special treatment or advantage given to American companies which are 100 percent owned by United States citizens and managed? Should there be any preference? Should we be open on that?

Mr. Reddy, I'd like to have your comments on that.

Mr. REDDY. Thank you, Mr. Thornton, I'll be happy to give you my personal views on that which, I think, reflect the views of our organization. We are committed to the principal that the United States must do what is necessary to revitalize our own manufacturing base using our tremendous resources to increase our own competitiveness. That is going to be the key to our success. Frankly, I find protectionist measures, exclusionary measures, and local content measures probably to hurt more than they help, unless they are directly related to a highly sensitive piece of national security technology. They detract attention from what we really must do. As a general matter—

Mr. THORNTON. I was not expressing my view on the thing. I was trying to draw from you, your views. In the Department of Defense acquisitions, certainly I hear you saying that there might be national security reasons for developing self sufficiency in certain areas. Am I correct in my understanding of your testimony?

Mr. REDDY. Yes, there are discreet technologies that which for national security reasons we must insure that we have and own adequate production facilities. Those technologies tend to be quite unique and not very many. Most of the technologies, including the ones on the OSTP list, are fairly generic to industry generally.

Mr. THORNTON. We were told yesterday by another panel that if we had needed spare parts for some of the high technology goods that we demonstrated in the Gulf recently, that we would have had to depend upon overseas suppliers of those materials.

Mr. REDDY. That is correct. However, I don't believe that given the dynamics of the global marketplace, where manufacturing has become global, that as a practical matter, there is not much that one can do in the regulatory or control area to affect that. What we really have to do is to develop our own competitiveness so that we are able to make those products with high enough quality and cost value that we can beat the competition. I think that is going to be the main way to safeguard our economic security interests.

Mr. THORNTON. There has been a lot of concern about the hollowing out of American manufacturing. The tendency of people in this country to move into service industries and forsake entirely certain areas of production and manufacturing. Mr. Koenig, are you concerned about that?

Mr. KOENIG. Generally, not.

Mr. THORNTON. Okay.

Mr. KOENIG. I find that there are different kinds of manufacturing. I represent a society that is involved in technology transfer. There are certain types of industries where it would take low skill people to do them, therefore, low cost. I don't think as Americans we really are interested in those types of industries. I think we are interested in using our basic strengths which is a very highly educated nation.

Mr. THORNTON. Would you be concerned about the hollowing out of manufacturing and forsaking the field of VCRs? As we were told yesterday, they were developed by Ampex, the invention being American, but the product being manufactured in Japan.

Mr. KOENIG. Not necessarily. If you understand how VCRs are made, it's basically a low tech type of activity now. Most of the work is being done by machines. If we own the companies that make the machines and sell them—

Mr. THORNTON. You are not concerned about the problems of international trade affected by going out of the television business, for example.

Mr. KOENIG. I used to work for a company that decided to go out of the television business because they thought that they could make more money otherwise.

Mr. THORNTON. They might have invested in tax free bonds.

Mr. KOENIG. No, not this company.

Mr. RITTER. Probably, defense electronics, if you and I are talking about the same company.

Mr. KOENIG. Right.

Mr. RITTER. Defense electronics, think of all the defense electronics that are sitting in 25 million American households today.

Mr. THORNTON. I appreciate the gentleman for adding that. How about High Definition Television? Are you concerned that we have no American company on its own that has the present capability to start from scratch and go into that field competitively?

Mr. KOENIG. That concerns me when we abandon high tech. I think there is a definite role for the American worker to be involved in producing high tech. I think we have to be very careful when we talk about abandoning jobs. If you are talking about jobs of monotonous assembly which have very little value added, you can either do it better by a machine or you can induce people to work for $.75 per hour to do that. I don't think that really adds to the quality of life.

Mr. THORNTON. Right.

Mr. KOENIG. We ought to be using our technology base to transfer R&D to new products. That takes skilled manufacture. That's where we're going to preserve jobs.

Mr. THORNTON. That is what I am referring to as the hollowing out of American industry. We are not continuing to develop the high technology capabilities. Mr. Reddy's fine book on industrial modernization, on page 8, shows the typical graph that occurs in item after item where manufacturing productivity results in a crossing of lines. With the trend line being that our productivity is declining and that our competitors is increasing. The question again and again is where do the lines cross? Are you concerned about these trend lines, sir?

Mr. Reddy?

Mr. **Reddy**. I'm deeply concerned about those trend lines, Mr. Thornton. My initial reaction, I want to make sure my views are clear on this, was to your question related to some exclusionary measures that are potentially—

Mr. **Thornton**. I wanted to hear your views on it. I, frankly, agree with your views on that. I think the answer is to increase productivity here, at home, and to tighten the relationship between research and development and the manufacturing process. I hear many people say that we ought to raise barriers and I wanted to get your views on the record on that.

Mr. **Reddy**. I'd be delighted. I'm opposed to raising those barriers but I'm very much in favor of government- industry cooperation in the kinds of technologies you mentioned. I am very concerned about our failure to get our national resources together around the technology of flat panel display. I don't know why it is that the Bush Administration is really more ideological than the Reagan Administration on this issue. It was the Pentagon under the leadership of Cap Weinberger and also under Bob Costello that came up with the notion that we should use the power of the Pentagon as the country's largest purchaser to try to drive quality manufacturing, making our government into a world class customer. Bob Costello and many of us have been talking a long time about dual use technologies. I did a survey under the auspices of the Center for Strategic and International Studies of how defense companies, themselves, feel about dual use technologies. The flat panel display of HDTV if a perfect example. The companies, themselves, are enthusiastically in favor of it. It helps them and the nation needs the capability to move back and forth between civilian and military production to meet changing security requirements, but the Pentagon is against developing dual use technologies. There is no explanation of this, other than the fact that they are adopting a purely ideological position which is not serving the national interests. It is not getting the taxpayer the value it should get out of its defense procurement dollar.

Mr. **Ritter**. If the gentleman would yield.

Mr. **Thornton**. I would be happy to yield.

Mr. **Ritter**. Just on that point. Haven't we made some dent? We did get some policy language adopted stating that precompetitive stage R&D, I don't know how you define that, was okay? That was a step forward from just basic science is okay. There is a lot of development and application in the precompetitive stage. We have been successful. NCMS, the National Center for Manufacturing Sciences, was able to get some kind of extensive grant last year from the Pentagon for $24 million or $30 million.

Mr. **Reddy**. Mr. Ritter, as I pointed out in my earlier comments on this, we certainly welcome all of those developments. We are very supportive of NCMS—

Mr. **Ritter**. Even HDTV. We've been able to push DARPA and now—

Mr. **Reddy**. It's improving, however, if we can come to the bottom line for a minute, I also pointed out that if you look at the Administration's budget for fiscal year 1992 and look at their R&D categories, the only category that has declined in an increasing budget, is the line for advanced manufacturing and materials research. What we're proposing is that the budget be reprioritized.

Mr. THORNTON. I want—

Mr. RITTER. If the gentleman will yield for one last comment.

We need a revolution in the Federal R&D economy to move towards helping "made in America" to succeed.

I thank the gentleman.

Mr. THORNTON. I thank the gentleman for his suggestion.

I would say that we also need a strategy. We need to carefully develop vision and a plan as to how to move this country forward. I would like to recommend to all committee members, your page 13, strategies for Federal action. It says that the paper does not attempt to address all aspects of public and private effort. It concentrates instead on a comprehensive strategy of Federal action which your organization believes will assist the U.S. in becoming a world leader in high quality manufacturing. By the year 2000, integrating Federal action and working with the private sector, proclaiming the modernization on page four of America's manufacturing infrastructure by the year 2000, as a national goal. A strong and continuing effort to explain the importance of this goal for the entire nation and not dissimilar is the suggestion by Mr. Morin that there is no substitute for comprehension on the full range of issues facing manufacturers. Certainly, Mr. Koenig, who suggests that we should have, on page three of his testimony, a summit of national public and private sector leaders. I think all of you are recognizing that what we are missing in this country with our vast resources and capabilities is a strategy, a vision, a determination to link together the various elements of our industrial and economic might in a coordinated way. I want to suggest that that is exactly what the chairman of this committee and many of its members have been seeking to do with these hearings and we would like to ask for your further thoughts on the need and importance of developing such a strategy.

Mr. Morin, since I quoted you first?

Mr. MORIN. I'd just like to say that I don't speak into this ideological debate that has turned into a theological debate that we've been engaged in over the years. I don't see how this national strategy is incompatible with either side. This should not be an ideological issue.

Mr. THORNTON. It's an American issue, isn't it?

Mr. MORIN. That's exactly right.

Mr. RITTER. They say, in effect, what works and what doesn't, what's smart and what's not.

Mr. MORIN. Yes, and everyone who has a future seeks to plan that future.

Mr. THORNTON. Mr. Ritter, I agree completely. I feel like I want to yield half of my time and welcome you to add your thoughts at any point in this thing. I find that we are on the same wavelength.

Mr. RITTER. Absolutely. The gentleman is a former university president and has thought quite deeply about some of these issues. I think we're at the water's edge. This is the future of America at stake and I don't think partisanship is part of it.

I thank the gentleman.

Mr. THORNTON. Thank you very much.

Mr. Chairman, thank you.

Mr. VALENTINE. Let me say to both of you that I think this has been a very meaningful series of questions and I want to yield to our distinguished colleague from California, Mr. Rohrabacher. Before I do, I want to explain to the panel that it was necessary for me to absent myself for part of the hearing. It should not be interpreted as any lack of resolve or concern about this. Before I yield to Mr. Rohrabacher, let me put a question which I will ask you to come back to later. It seems to me that while the British place the Crown Jewels in the Tower and protect them, that we allow anybody that has the money to come and purchase America's manufacturing crown jewels. We put billions of dollars of the taxpayers money into research and development and develop all of these miraculous contraptions and the Japanese come and buy them. Shouldn't we be able to figure out some way to prevent that from happening. I know we believe in freedom to do almost anything. Should we be able to craft or put together some mechanism where we at least require that a class of stock for an American company would have a special designation. Shouldn't we look at our own transferency of ownership if our overseas competitors can change or shroud or hide the ownership from public view? That is a question and I ask you to answer or come back to it later on. I yield to my distinguished colleague from California, Mr. Rohrabacher.

Mr. ROHRABACHER. Thank you, Mr. Chairman.

First, I'd like to ask, outside of the range of national strategy and a macro approach to making us more efficient and competitive, a question that deals with a micro or specific area. Is it Mr. Koenig? Is that how you pronounce your name?

Mr. KOENIG. That's correct.

Mr. ROHRABACHER. I apologize for not being here earlier. We have a zillion different functions that we are supposed to serve here in Congress. I'm sorry that I missed the earlier part of your testimony. If this is repetitive, I apologize. We seem to have had a lot of innovation in American business in terms of producing machine that do manufacturing jobs. I'm wondering if we have a potential of automating not just some of the jobs on the production line, but automating some of the white collar functions that are done by American business. What do you see as the potential of computerization and automation of the white collar end of American business?

Mr. KOENIG. We've probably gone a long way towards automating the white collar activities. We have word processors which took the place of typewriters which took the place of—

Mr. ROHRABACHER. What about decision making type of functions.

Mr. KOENIG. There is a whole series of technology that we're aware of and that our society is arranging for technology transfer programs, conferences of artificial intelligence where the basic idea is to obtain the best ideas of the experts. Then that is put into a computer algorithm and a strictly if/then type of statement that a computer typically runs on the whole basis of artificial intelligence is based on is if/then/probably then type of activity based on probability and statistics, some inductive and deductive reasoning type of algorithms. It is possible to come up with programs that would again automate these type of decision making activities. In some areas it becomes very interesting and very critical. In the area of medical diagnosis, I think it is most advanced in these areas that they are using these types of artificial intelligence programs to diagnose patients where you can't always go to the expert in the medical center or hospital. You may be up in the Yukon, in Alaska, or someplace remote, but if you have a telephone line and a computer terminal and the proper access code you can get into these artificial intelligence type of things. In the area of manufacturing, several preventive and diagnostic tools for maintenance have been developed. One of the more famous ones is the Charlie Program developed by General Motors for maintenance of machine tools where the maintenance technician has at his beck and call, the entire universe of knowledge that goes with diagnosing failed machine tools. There is a lot of that going on but when you talk about automation of the workplace, we have a whole new way of doing engineering these days. We have engineering work stations which are combination of word processors, calculators, drafting machines, and instructions to the factory floor done by one person. We have now capabilities of joining manufacturing and engineering technologies into one. We have synergism between those two functions.

Mr. ROHRABACHER. Do you think that this artificial intelligence will make us see computers coming in and making decisions that are now made like scheduling and purchasing.

Mr. KOENIG. That's already there. In the area of scheduling and purchasing, we have manufacturing resources planning activities, MRP, that already does that. The algorithms of your purchasing policies and your manufacturing policies are built into a computer program which then schedules the shop and based on the feedback of activity of the factory floor, the program then reschedules the shop. We can do this in a dynamic mode which was never before possible.

Mr. ROHRABACHER. Where do you fit this into the future of American competitiveness? Is this an area that will really expand in the future?

Mr. KOENIG. This is an area where we're leading. The application of MRP and the synergism in systems control within a factory, we definitely have the lead in that. The more we can integrate this activity of factory control into business control strategies, the more competitive advantage we'll get. I believe we are already leading there. I know our society is very active in technology transfer programs, conferences and publications in this particular area.

Mr. ROHRABACHER. Mr. Reddy?

Mr. REDDY. Yes, sir.

Mr. ROHRABACHER. You are mentioning getting the most out of our defense dollars and that when they do research and come up with new products for the defense industry. I've been seriously concerned that many times we spend money in the defense industry in order to come up with new innovations that can be put into new products, for example, airplanes. We end up selling the Japanese this technology and it's derivative of American defense dollars. The Japanese seem to be very insistent on people coming in and doing joint ventures in their country rather than buying products from us. Is it possible to have legislation that would say that the Japanese would have to buy a finished product. We have the FSX Fighter deal, for example. It was a major issue a year and a half ago. Would it be possible for us to say that any technology derived from defense dollars can be sold only as part of a finished product or would that be an unworkable type of arrangement?

Mr. REDDY. That issue was debated at some length during the FSX crisis. Certainly, as an American, I strongly favor promoting our products as much as we possible can. I think that most countries still work very much in a sense of their national interests, including the Japanese. Countries don't tend to be globalized, companies, however, are globalized.

Mr. ROHRABACHER. What we have now in machines and the things that we have, are they so filled with components from all over the world, that it would be impossible for us to say I'm sorry, you can buy the finished product but, you can't buy any of the technology?

Mr. REDDY. I think that's basically right. As I mentioned before, there may be some very esoteric technologies related to weaponry and so forth that we must keep to ourselves, but for the most part, the example that was sighted before about the fact that we were heavily dependent on foreign suppliers for part used in the Gulf War was absolutely right. That is a reality of the modern marketplace. It has significant political effects, by the way. It affects our ability to maintain a long term military campaign somewhere which is not popular with some of our allies. Our ability to provide these spare parts and to sustain such a campaign is much more circumscribed than it used to be. Those are realities of the modern global economy.

Mr. ROHRABACHER. When you have a defense related advancement, something that came right out of our defense budget, you wouldn't be for legislation that would ban the sale of this to potential competitors?

Mr. REDDY. I think you have to look at that on a case by case basis. It would have to be a type of technology which would be so closely tied to purely military use that it could be justified. It is hard to find those examples since any product has multiple parts and components in it and some of those components and parts will, inevitably, come from overseas sources.

Mr. ROHRABACHER. I am very concerned and I know my chairman is concerned about these things as well. In my area of the world, we have a strong aerospace industry. We are spending billions of dollars in defense dollars that help bolster the aerospace industry, civilian and defense, then we end up dealing with Japan in a commercial way that may permit them to have a competitive aerospace industry based on things that we've developed from our defense dollars, 20 years down the road. I'm trying to figure out how we can handle that? How we can stop that? Do you have a suggestion?

Mr. MORIN. Could I comment on that?

Mr. ROHRABACHER. Sure.

Mr. MORIN. I understand the concerns. I see where you are going and in many ways share some similar sentiments. I'm afraid that the way you get to do that by enacting a whole layer of regulation and legislation that will make it more difficult to do business. I don't see that as the way to do it.

Mr. ROHRABACHER. That is what I'm afraid of.

Mr. MORIN. That's what we're very afraid of. I'd like to refer back to something in my prepared testimony. At the end, there is a chart. It is entitled, The Competitiveness Agenda vs. The Congressional Agenda. It gets back to the point I tried to make in my spoken remarks that you can't look at technology policy alone. You can't look at things in isolation. If you see a problem like this where you think technology is going offshore, it's impossible to solve just that problem.

Mr. ROHRABACHER. I certainly agree with that. I am less attracted to have the Government develop some grand industrial strategy as some of the folk in the other aisle. It's an honest disagreement in terms of the way we approach things. It seems to me, when we talk about selling the Crown Jewels, the fact is that the aerospace in the United States is one that is a crown jewel. It is really important to our economy, not only in California, but to our overseas trade and our trade balance. When we end up producing technology that will produce a jet fighter, it seems to me that it's pretty ridiculous for us to provide that which we put up billions of dollars of research in, to provide it to the Japanese who can then develop an industry that will compete against us.

Mr. MORIN. I think the aerospace industry example is a good one. Look at what the aerospace industry has done as an industry. They have come up with their key technologies program for the 1990s. As an industry, these companies have come together and identified those technologies that they need to be ahead in to keep them competitive in the years ahead. As an industry, they have organized and established pretty detailed plans, technical road maps, on how to get there from here. When you talk about selling the Crown Jewels, these are decisions that a company has to make on its own. They are their crown Jewels. It is their intellectual property.

Mr. VALENTINE. That is where the problem is gentlemen, if I might interrupt.

The Crown Jewels, in many instances, are there as a result of tax money in the billions of dollars.

I don't want to interrupt the gentleman. I will give him some extra time.

Let me suggest to you that when business people come to us and say we need tax credits, we need reform in the tax law, and we do that. We enhance the profitability of that company and the next thing we know, the company has been bought by the Japanese. The American taxpayers have further enhanced our overseas competitors. Is there such a thing as too much freedom?

By God, how can one say that?

Mr. ROHRABACHER. I wouldn't think that there is too much freedom, but there may be too much subsidization.

Mr. VALENTINE. We say that we can't do these things because don't give us more book work. Don't make things more complicated for us, but we are told that the Japanese government does the same thing for them. You can't get your rusty-dusty tail into those companies over there. You can't do it. They won't have you. That's what T. Boone Pickens, I always thought it should be Pickens Boone, tells us. There is bound to be something we can do.

Lincoln, during the Civil War, suspended the Constitution and invoked martial law. Someone said, Mr. President, you can't do that. Lincoln said, "If I don't do this, there won't be any Constitution." If we don't do something, there might not be any American business. It will be a facade with all of the small print in Japanese.

Excuse me. I yield back to the gentleman.

Mr. ROHRABACHER. Of course, coming from North Carolina and quoting Lincoln, that was a very politically courageous thing to do.

Mr. VALENTINE. I should have quoted Lincoln and referred to the War for Southern Independence.

[Laughter.]

Mr. ROHRABACHER. I sat down with a major aerospace firm and they told me that if they didn't get a certain contract that all of the technology that they developed in this particular aircraft would be sold to the Japanese. The chairman is right, that wasn't their crown jewels because it was the defense dollars that went into that company that created that asset. I am perplexed about that.

Mr. MORIN. Could I comment on that?

Again, I see where you're going and I don't disagree with that. My concern is what is better, to have that technology evaporate because no American wants to buy it or that somebody else buys it and develops it? I don't know.

Mr. ROHRABACHER. In this case, my option is that the Japanese have a societal policy that they are going to set up policies that help them absorb other people's technology and capabilities. Especially if those technologies and capabilities have been developed through a subsidized process through the other government. They have that. We just don't seem to have the same willpower to say, I'm sorry, if you want to buy a jet airplane from us, you can buy the jet airplane. You can't buy the technology so that you manufacture it based on our technology in your country. It seems to me there's something there that can be done to handle, what I see as a threat, to one our crown jewels, the aerospace industry. I'm not giving you the answer. If you have some thoughts on this after the hearing and you want to write me a letter about this, I'd be very pleased to hear from you.

Mr. VALENTINE. If you write Mr. Rohrabacher, send us a copy. We don't want him to know anything we don't.

Mr. ROHRABACHER. Thank you very much, Mr. Chairman.

Mr. VALENTINE. Thank you, sir.

I believe that whichever way we approach this situation, someone will always be right over our shoulder. Sometimes, it's the Swedish, the Japanese, or the Germans. To me it is an inescapable fact of history that while the resources of the United States, since the end of the ceremony on the deck of the Missouri, have been consumed in an effort to protect the free world. What could we have done in this Nation, if we had been able to devote into domestic matters what we have devoted to the defense of Europe and Japan over the last 40 years. Let me say that while I have missed a lot of this hearing, I believe this to be a most productive exercise. I don't mean to suggest that we haven't in the past, but we have received today a combination of questions and answers. Some of you have come here in a position to say to us that these are some of the things that we ought to do. That is what we need, not someone saying this is the problem, you figure it out. We aren't that smart. Well, Mr. Rohrabacher is.

Let me ask you if you'd go back to my question. Why can't we figure some way to prevent and preserve our freedoms? To prevent the Japanese from purchasing American companies, thereby purchasing that which the taxpayers paid for? What do you think about having a class of stock for an American company that would have the requirement that 100 percent U.S. principals and 100 percent U.S. ownership? What do you gentlemen think about that?

Mr. Reddy?

Mr. REDDY. Mr. Chairman, I think that would be complex to affect. Given the fact that many of our small companies don't have the technology or the capital and they turn to foreign sources. Many of our companies, including the auto supplier companies around Detroit, are actually welcoming foreign investment. A lot of our business leaders are saying, foreign investment was crucial to our development 100 years ago. I fully sympathize—

Mr. VALENTINE. I'm not suggesting that it be mandatory. I'm suggesting that there be a category where the Federal Government in defense of the money for R&D will go to deal a little bit differently with a company that is going to be 100 percent American. Should there be some penalty, for a person that seeks overseas investors?

Excuse me, go ahead.

Mr. REDDY. Mr. Chairman, I have a hard time interpreting that. Maybe, I don't understand it well enough. We can talk about it after the meeting. It is essentially a protectionist type of measure which runs against the dynamics and trends of modern business. However, there are a number of things that can be done. I'll give you one example. One of the main reasons why so many of our companies, particularly smaller companies, are being acquired is that they do not have the capital resources to move up to the next technology, plant, or equipment. This gets back to the whole problem of shortage of capital and the quarterly return syndrome. We have proposed in our own concepts, not only some tax relief in this area through the investment tax credit approach I mentioned earlier, and accelerated depreciation schedules, but also the development of a secondary financial market. Unless you quiver and fall right off your chair, let me tell you that we are looking very hard, at our organization, at the concept of a secondary financial market to provide longer term industrial mortgage loans. One of our options is to have this secured not by the government, but pooling some of the funds form the large credit corps and big companies into a pool which can be made available to smaller firms to get longer term capital. We would also like to see this network of deployment centers which we mentioned earlier being associated with this so that lenders could have a better picture of the credit worthiness of some of the smaller companies applying for these loans, technical engineering evaluations, etc. That's a private sector model which involves a little bit of government involvement, not much. That's the kind of solution that we can achieve through our own resources without any resort to protectionism in a natural healthy way.

Thank you.

Mr. VALENTINE. Mr. Koenig?

Mr. KOENIG. Speaking for ASME, the Society, itself, would have no official position on an activity such as this. We are a technical society and our purview is to enhance technology transfer. We are basically and American society, but we do have international chapters. I know we have no position on that topic.

Speaking as an individual, I have felt the brunt of Japan, Inc. Anything to slow those guys down would be most welcome. Instinctively, I say no I wouldn't want Government interference in setting up some sort of a corporation or device that says that if it is fully American owned, it gets better support than a company that is not totally American owned. That's my instinctive reaction to that. I believe in the individualism and we can beat them by ourselves. I also think that there may be some better ways of doing this sort of thing. If you want people to do things, hold that golden carrot in front of people. Here is the reward. Instead of selling technology to the Japanese, either sell it or go into a joint venture with other smaller firms to implement it and affect a technology transfer. Tear down the barriers and make it happen faster. There could be some sort of tax incentives or some other grant money to make that happen. That would be the way I would prefer to see it happen. If you are an American firm—

Mr. VALENTINE. That's the problem. Nobody can figure out a way to keep from exporting tax incentives.

Mr. KOENIG. If you were an American firm and there is technology that has its origins traced to the taxpayers and you are in control of it, there ought to be an incentive for them to sell that to other American firms who are going to commercialize the idea rather than going overseas.

Mr. ROHRABACHER. You are saying incentive and not punitive.

Mr. KOENIG. Yes, incentive, not punitive. If you are going to sell it to a Japanese firm and that's the way you want to do it then whatever the rules and regulations that the IRS has in place now is fine. If you sell it to an American firm with the promise to help that firm commercialize it, you get some sort of a tax incentive or some other carrot that makes it more profitable and palatable for you to do that. I think that's the way to do it. I think some foreign countries do that. I think Canada does that.

Mr. VALENTINE. Mr. Morin?

Mr. MORIN. NAM has no institutional position on the stock question. I don't know if we would consider it and what position we would have. Again, I'd like to raise things to a more nebulous level. This is a tactic and I don't know whether it's the right tactic. What we need is a strategy. I'm not sure if a series of tactics constitutes a strategy or not. At some point you have to draw a line in the sand to say that this is where the strategy starts. I don't know if this is it or not. Again, I would like to counsel that we look at things in their totality and if you change enough other things, measures like this don't become that necessary. If we make the business environment better, then measures like this become insignificant.

Mr. **Valentine**. Like quality.

Mr. **Morin**. We all have our own roles to play. That is one of industry's key roles.

Mr. **Valentine**. We do have a situation where it seems to some of us that planned obsolescence has become a trap.

We are going to have to go and I don't want you to wait here until we come back.

Let me ask this final question and ask you to please give it your attention. If you have thoughts, please give us written answers.

Do you think that we should join the Japanese in the international intelligent manufacturing systems consortium?

Dana, do you have anything?

Mr. **Rohrabacher**. Can we get a yes or no on that question?

Mr. **Valentine**. If you can give us a yes, no, or maybe?

Mr. **Morin**. I would say—

Mr. **Valentine**. We have to vote here.

Mr. **Morin**. I would say yes, provided the program is structured so that it benefits American manufacturers to the same extent others benefit and American manufacturers see their interests. It's a qualified yes.

Mr. **Valentine**. Mr. Koenig?

Mr. **Koenig**. I'd agree with Mr. Morin.

Mr. **Valentine**. Mr. Reddy?

Mr. **Reddy**. I am familiar with this subject from the beginning and I have a qualified yes to that as well, as long as our intellectual property rights are protected. However, what that issue about the Japanese means to me, it dramatizes the seriousness with which are taking manufacturing technologies. We should give them equal seriousness. Our Federal commitment to R&D in manufacturing technologies is a tiny fraction of what the Japanese and German government commitment is to those technologies.

Mr. **Valentine**. Thank you very much. You have made a significant contribution to a solution for the problem.

This meeting stands adjourned.

[Whereupon, at 12:17 p.m., the subcommittee adjourned, to reconvene at the call of the Chair.]